

**BOARD OF PATENT APPEALS AND INTERFERENCES  
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

**In re Application of:  
OTTO, et al.**

**Serial No.: 10/792,056**

**Filed: March 3, 2004**

**For: Method for Lubricating and/or  
Reducing Corrosion of Drilling  
Equipment**

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**Group Art Unit: 1797**

**Examiner: Ellen M. McAvoy**

**Atty. Docket: 154-28553-US**

**BRIEF FOR APPELLANT**

Commissioner for Patents  
PO BOX 1450  
Alexandria, VA 22313-1450

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### REAL PARTY IN INTEREST

The real party in interest in this appeal is Baker Hughes Incorporated.

### RELATED APPEALS AND INTERFERENCES

Appellant, its legal representative, and its assignee are unaware of any other appeals or interferences that will directly affect or be directly affected by or have a bearing on the Board's decision in this pending appeal.

### STATUS OF CLAIMS

Claims 193-221 were finally rejected in the final action mailed December 4, 2008. A notice of appeal was filed by facsimile and received in the United States Patent Office on March 13, 2009.

### STATUS OF AMENDMENTS

All amendments have been entered. A copy of appealed claims 193-221 appears in the Claims Appendix.

### SUMMARY OF CLAIMED SUBJECT MATTER

The pending claims are directed to “a method of providing **extreme pressure lubrication** of drilling equipment during drilling operations.” Claim 1 (emphasis added). The method comprises “providing a drilling fluid . . . comprising a **continuous phase** comprising as an integral component a dispersion comprising a quantity of **insoluble fatty acid soap particles comprising alkali metal**.” The method further comprises “drilling through a subterranean formation using the drilling fluid system under conditions effective to . . . **react the insoluble fatty acid soap particles with one or more metal surfaces** of drilling equipment.” See claim 193 (emphasis added). The claims specify that the reaction produces a lubricating film which

provides effective lubrication to metal surfaces subject to friction even under extreme pressure testing conditions. Specification, p. 3, ll. 20-p. 4, l. 1.

Claims 202-210 and 218-221 specify that the drilling fluid system comprises “polymers comprising acrylamide monomers.” Claims 202-210 and 218-221 also directly or indirectly specify “using the drilling fluid system under conditions effective to **maintain effective rheological properties** and gel strengths and to maintain effective fluid loss control properties.” Claim 202 (emphasis added).

### **GROUND OF REJECTION TO BE REVIEWED ON APPEAL**

1. Whether claims 193-221 are obvious under 35 U.S.C. § 103(a) over U. S. Patent No. 5,658,860 to Clark et al, alone, or in combination with U.S. Patent No. 6,403,537 to Chesser, et al.

2. Whether claims 202-210 and 218-221 are obvious under 35 U.S.C. § 103(a) over U. S. Patent No. 5,658,860 to Clark et al, alone, or in combination with U.S. Patent No. 6,403,537 to Chesser, et al.

3. Whether claims 197-201 and 211-221 are obvious under 35 U.S.C. § 103(a) over U. S. Patent No. 5,658,860 to Clark et al, alone, or in combination with U.S. Patent No. 6,403,537 to Chesser, et al.

### **ARGUMENT**

#### **I. Introduction**

The claims are directed to a method of providing extreme pressure lubrication during drilling operations by providing the continuous phase of a drilling fluid with a dispersion comprising a quantity of insoluble fatty acid soap particles comprising alkali metal. Alkali metals have a relatively **low valence**. “Previous [extreme pressure] lubricants, sometimes called boundary lubrication additives, generally used fatty acid soaps of metals having a relatively **high valence**, such as aluminum.” Specification, ¶ [0010].

The specification explains that “[m]ost current drilling fluid systems comprise polymeric materials which tend to react with metals having valences greater than 1. The reaction between

the polymeric material and a high valence metal in a fatty acid soap adversely affects drilling fluid properties.” Specification, ¶ [0010].

The Declaration of Michael Otto (Exhibit A) explains that:

During the early 1980’s, I was working with a BHDF customer on location in the Imperial Valley of California. Otto Decl., ¶ 4. At least some of the wells drilled by the BHDF customer in the Imperial Valley were geothermal wells. Geothermal wells can have extremely high bottom hole temperatures (in excess of 500° F). Otto Decl., ¶ 5. The mud systems used by BHDF to drill geothermal wells in the Imperial Valley during the 1980’s comprised high temperature acrylamide based copolymers. Otto Decl., ¶ 6.

While drilling one geothermal well using a BHDF high temperature, copolymer mud system comprising acrylamide copolymer, the mud system was treated with a high temperature, extreme pressure lubricant called “LUBRI-FILM.” Otto Decl., ¶ 7. LUBRI-FILM is an aluminum stearate/lignosulfonate dispersant. Otto Decl., ¶ 8. The mud system treated with LUBRI-FILM exhibited reduced torque and drag, but also exhibited an abnormal increase in mud viscosity. Otto Decl., ¶ 9. The abnormal increase in viscosity was believed to be partially due to a solids build up in the mud system. In order to resolve the solids build-up problem, a large portion of the mud system was displaced with new drilling fluid, producing conditioned mud. Otto Decl., ¶ 10.

The conditioned mud was subjected to pilot testing on location at elevated temperatures to evaluate the effect of LUBRI-FILM on the conditioned mud. No abnormal viscosification was observed during the on site pilot testing. Otto Decl., ¶ 11. Based on the successful pilot test, a minimal treatment of approximately 1 ppb of the LUBRI-FILM was added to the mud system. Otto Decl., ¶ 12. **Within 48 hours after adding the 1 ppb of LUBRI-FILM to the mud system, routine product additions could not be made to the mud system due to the occurrence of abnormal viscosity/abnormal gel strength.** Otto Decl., ¶ 13 (emphasis added).

All product additions to the mud system were stopped for a period of days to determine what, if any, products could be added to the conditioned fluid. Otto Decl., ¶ 14. A decision was made to stop using LUBRI-FILM in mud systems comprising acrylamide based polymers and copolymers. This decision was made even though the operator and rig personnel were impressed with the performance of LUBRI-FILM and with its bluing effect on the drill pipe. Otto Decl., ¶ 15.

The need remained for an extreme pressure lubricant that could be used to treat high temperature mud systems comprising acrylamide based polymers and copolymers. Otto Decl., ¶ 16.

As seen from the following discussion, the examiner has not pointed to any teaching or suggestion in any reference of the claimed method of “providing **extreme pressure lubrication**

of drilling equipment during drilling operations” comprising “providing a drilling fluid . . . comprising a **continuous phase** comprising as an integral component a dispersion comprising a quantity of **insoluble fatty acid soap particles comprising alkali metal**” and:

drilling through a subterranean formation using the drilling fluid system under conditions effective to **maintain effective rheological properties and gel strengths and** to maintain effective fluid loss control properties, and to **react the insoluble fatty acid soap particles with** one or more **metal surfaces** of drilling equipment in contact with the drilling fluid system, thereby producing lubricated drilling equipment comprising one or more metal surface comprising a substantially continuous lubricating film providing improved lubricity as reflected in **an increase in lubricating film strength compared to a control during extreme pressure testing.**

Claims 193 (emphasis added). See also claims 197, 202 and 211.

The following discussion also reveals that the rejection disregards prior art that **teaches away** from the claimed method.

## **II. Friction Reduction vs. Extreme Pressure Lubrication**

It is important to recognize that drilling equipment requires several different types of lubrication depending upon conditions during drilling operations. One type of lubrication (friction reduction) **reduces the coefficient of friction** at metal surfaces under relatively low pressures and loads. Friction reducers promote efficiency when drilling operations require moderate reductions in drag or torque. Friction reducers are evaluated in the laboratory using spindle speeds of about 60 rpm and pressures of about 150 in-lb or less. Friction reducers may be relatively low in viscosity, and are **not designed to react with the metal surface** of equipment to produce a coherent lubricating film.

Another type of lubrication, known as “extreme pressure” lubrication, **reduces the occurrence of metal-to-metal or metal-to-rock contact and seizure** at higher pressures and loads. Extreme pressure lubricants are designed to **react with the metal surfaces** of drilling equipment to provide a coherent lubricating film effective to **reduce the occurrence of metal-to-metal or metal-on-rock contact and seizure** at higher pressures and loads.

This difference is made clearer by Exhibit B, a “Model 212 EP/Lubricity Tester Instruction Manual.” Exhibit B demonstrates that there are **two different tests** for friction reduction and extreme pressure lubrication. A “Lubricity Test” measures the coefficient of friction for a given lubrication (friction reduction). A Lubricity Test is found in Section 4 of

Exhibit B (p. 11-14).<sup>1</sup> An “Extreme Pressure (EP) Test” determines “the **load or pressure** the lubricant will hold without a complete *breakdown of film strength*. This is termed a *PASS*. A complete breakdown of film strength allows *metal-to-metal contact*, which causes *galling* and is termed a *SIEZURE*.” Exhibit B, p. 18 (emphasis added). An “Extreme Pressure (EP) Test” begins at p. 15 of Exhibit B.<sup>2</sup>

### III. **The Prior Art Teaches Away from the Claimed Method for Providing Extreme Pressure Lubrication**

A person of ordinary skill in the art at the time the invention was made (a “PHOSITA”) would have been familiar with the teachings of U.S. Patent No. 3,047,494 to Browning (“Browning”). Browning acknowledges that

the prior art did not satisfactorily solve the problem of effectively providing E.P. [Extreme Pressure] lubrications for muds used under gulf coast drilling conditions. In particular, the E.P. lubricating muds prepared according to previously indicated formulations have not proved satisfactory for the more difficult and costly offshore or deephole drilling conditions.

Browning, col. 2, ll. 14-22. Browning explains that:

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<sup>1</sup>In a Lubricity Test: the spindle speed is set at 60 rpm with an applied torque of 150 inch-pounds (16.95 N-m) pressure for 3 to 5 minutes. The torque reading is recorded. Nos. 2-4, Exhibit A, p. 14. The coefficient of friction is determined by dividing the recorded torque reading by 100. *Id.*, No. 1 under “Sample Lubricity Calculations.”

<sup>2</sup> In the EP test: the spindle speed is set at 1000±100 RPM and the pressure is increased at a rate of 5 inch-pounds (.565 N-m) per second until the desired torque reading, or until a seizure occurs. To determine the lubricity film strength, the pressure on the test block at the time the test was stopped is divided by the scar area on the block.

$$P = T / (1.5 \times L \times W)$$

Where:

P = Film strength (PSI)

T = Torque meter reading (pounds)

W = Scar width (inches)

L = Scar Length (inches)

*Id.* The torque may be increased until a seizure occurs if the maximum lubricity film strength is to be determined.

*Id.* The procedure can be repeated at reduced torque levels until a pass is achieved. *Id.*

Caution is required when running an EP test because, due to the extreme friction between the ring and the block, the fluid may reach the boiling point. The block and ring are specific to which test is being performed

Some existing materials such as sulfurized fatty acid compounds, esters, and the like, may be used to provide E.P. properties in essentially fresh water muds. These materials, however, lose their effectiveness when the pH exceeds 10.5 or thereabouts, will tolerate only about 10% oil, and begin to give erratic results when the calcium ion content of the mud filtrate exceeds about 80 p.p.m.

Browning, col. 2, ll. 23-29. *See also* U.S. Patent No. 3,048,538 to Rosenberg, col. 1, ll. 14-31, esp. ll. 30-31 (drilling fluids comprising alkali metal soap can be contaminated with calcium ions during use, resulting in **“curds of an insoluble calcium soap form[ing] and separat[ing] from the drilling mud . . . [that] seriously interferes with control of the mud system.”**)

Rosenberg, col. 1, ll. 30-33.

Browning reports that “for any E.P. additive to function effectively in any drilling mud, the additive must be present in the mud as a water insoluble colloidal or near colloidal dispersion. **Failure to provide E.P. lubrication protection occurred whenever an E.P. product of known effectiveness flocculated, coalesced or otherwise lost its stable dispersion characteristics.**” Browning, col. 2, ll. 41-67 (emphasis added).<sup>3</sup> Browning also reports that “oil insolubility of the E.P. additive was . . . a very important factor in preparing the E.P. additives for gulf coast drilling conditions. Such oil insoluble additives were found to include the metal soaps of fatty acids **other than the alkali metal soaps.**” Browning, col. 3, ll. 4-25. In particular, Browning suggests the use of aluminum stearate. *Id.*

**Browning teaches away from selecting alkali metal soaps as extreme pressure lubricants.** This is strong evidence of non-obviousness. *In re Hedges*, 228 U.S.P.Q. 685, 687 (Fed. Cir. 1986), quoting *W. L. Gore & Assoc. v. Garlock, Inc.*, 220 U.S.P.Q.303, 312 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984).

#### IV. **THE EXAMINER HAS NOT MET HER BURDEN TO ESTABLISH THAT THE PENDING CLAIMS ARE OBVIOUS**

The following discussion reveals that: (1) the examiner **has not met the flexible TSM test**, *Ortho-McNeil Pharmaceutical, Inc. v. Mylan Laboratories, Inc.*, 86 U.S.P.Q.2d 1196, 1201-

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<sup>3</sup> Rosenberg attempts to avoid the harmful effects of calcium ions on alkali metal fatty acid lubricating additives by incorporating dispersing agent(s) “in the drilling muds to disperse the insoluble calcium soaps and prevent their separation to interfere with drilling processes.” Rosenberg, col. 1, ll. 69-71. Unfortunately, dispersing agents are likely to interfere with maintaining the insoluble colloidal or near colloidal dispersion which is required “for any E.P. additive to function effectively in any drilling mud.” Browning, col. 2, ll. 41-42.

02 (Fed. Cir. 2008)(emphasis added); (2) the examiner has not established that the claims are directed merely to “the **predictable use of prior art elements according to their established functions,**” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 127 S.Ct. 1727, 82 U.S.P.Q.2d 1385, 1396 (U.S. 2007) (emphasis added); and, (3) the examiner has not established an **apparent reason to combine known elements** in the fashion claimed, *id.* (emphasis added).

**A. CLAIMS 193-221**

Claims 193-221 all specify a method of extreme pressure lubrication during drilling operations using a drilling fluid system comprising insoluble fatty acid soap particles comprising **alkali metal**. Claims 193-196 specify that the alkali metal is “selected from the group consisting of lithium, potassium, rubidium, cesium, and combinations thereof.”

**1. The Examiner has not Established that the Claims Are Directed Merely the Predictable Use of Prior Art Elements According to their Established Functions**

The examiner has not even established that Clark teaches or suggests a method of extreme pressure lubrication. The examiner certainly has not established that the claims are directed merely to the predictable use of prior art elements according to their established functions.

**a. The Clark patent**

Clark describes a “well fluid emulsion having a water phase and an oil phase of a sulfurized alcohol and a naturally occurring fat, oil, or derivative thereof.” Clark, abstract. Clark explains that “the inventors have surprisingly discovered that an otherwise toxic sulfurized alcohol can be rendered non-toxic by solubilizing such sulfurized alcohol in an alcohol.” Clark, col. 3, ll. 4-7.

Clark’s fluid is “an oil-in-water emulsion well fluid, with oil or hydrophobic phase, and a water phase” wherein “the base fluid is water . . . [and] the oil-phase of the oil-in-water well fluid . . . may include any non-water soluble material that will provide the required rate of penetration or lubrication . . . [including] **naturally occurring fats and oils.**” Clark, col. 4, ll.

45-58 (emphasis added). Clark describes a variety of suitable naturally occurring fats and oils that allegedly would be suitable for use **as the internal “oil phase” of Clark’s fluid**:

Where environmental concerns exist, it is preferred in the practice of the present invention that naturally occurring fats, oils, hydrocarbons, and derivatives thereof be utilized **as the oil phase component of the oil-in-water emulsion well fluid**. Preferably, the naturally occurring fats, oils, hydrocarbons, and derivatives thereof be utilized **as the oil phase** component of the oil-in-water emulsion well fluid are selected to be non-toxic and/or biodegradable.

Clark, col. 4, l. 63 - col. 5, l. 3 (emphasis added) Clark also states that:

Derivatives of the above described fatty acids may also be utilized in the present invention. Such derivatives include **alkali**, alkaline earth, or transition **metal substituted fatty acids**; oxidized fatty acids; amides of fatty acids; salts of fatty acids; esters of fatty acids; sulfated fatty acids; sulfonated fatty acids; alkoxyated fatty acids; phosphatized fatty acids; and mixtures thereof.

Clark, col. 5, ll. 56-62 (emphasis added).

The examiner contends that the foregoing teaching in Clark renders the claimed method of extreme pressure lubrication obvious.

**b. The examiner has not established that Clark teaches or suggests the claimed method of extreme pressure lubrication**

The rejection should be reversed. The examiner has not established that Clark teaches, suggests, or otherwise would motivate a PHOSITA to perform the claimed method of extreme pressure lubrication.

The examiner certainly has not pointed to any teaching or suggestion in Clark of the claimed method of “providing **extreme pressure lubrication** of drilling equipment during drilling operations” comprising “providing a drilling fluid . . . comprising a **continuous phase** comprising as an integral component a dispersion comprising a quantity of **insoluble fatty acid soap particles comprising alkali metal**” and:

drilling through a subterranean formation using the drilling fluid system under conditions effective to **maintain effective rheological properties and gel strengths and to maintain effective fluid loss control properties**, and to **react the insoluble fatty acid soap particles with** one or more **metal surfaces** of drilling equipment in contact with the drilling fluid system, thereby producing lubricated drilling equipment comprising one or more metal surface comprising a substantially continuous lubricating film providing

improved lubricity as reflected in **an increase in lubricating film strength compared to a control during extreme pressure testing.**

Claims 193 (emphasis added). See also claims 197, 202 and 211.

The examiner has not established that Clark describes “a finite number of known [materials] that predictably act as” extreme pressure lubricants. *Ex Parte Fu*, 89 U.S.P.Q.2d 1115, 1121 (Bd. Pat. App. & Int. 2008). The examiner has not established that PHOSITA would select **insoluble** alkali derivatives of naturally occurring fats and oils from among the many possible fatty acid derivative listed in Clark’s for any particular purpose. In fact, based on the foregoing teachings of Clark, a PHOSITA would select *liquid* derivatives of Clark’s “naturally occurring fats and oils” **for use as Clark’s “oil phase.”** The examiner also has not established that a PHOSITA would have been motivated to provide Clark’s fluids with a “**continuous phase** comprising as an integral component a dispersion comprising a quantity of **insoluble** fatty acid soap particles comprising alkali metal.” Claim 193. See also claims 197, 202, and 211.

The examiner certainly has not established that a PHOSITA would have a reasonable expectation that, if selected, the alkali metal derivatives of Clark’s “naturally occurring fats and oils” would “*react . . . with one or more metal surfaces* of drilling equipment” to produce a lubricating film which provides effective lubrication to metal surfaces subject to friction **even under extreme pressure testing conditions.** Specification, p. 3, ll. 20-p. 4, l. 1 (emphasis added). This conclusion is supported by Clark’s Example 1, in which a low load, low pressure lubricity test is performed.<sup>4</sup> Clark’s Examples do not reflect Extreme Pressure Testing.

**2.     The examiner has not established an apparent reason to combine the references in the fashion claimed**

The examiner cites “Chesser et al [‘Chesser’] as teaching that drilling fluid systems conventionally contain acrylamide monomers.” Final action, p. 2.

The examiner does not even attempt to establish that Chesser provides an **apparent reason to combine known elements** in the fashion claimed. *Id.* (emphasis added). The examiner does not point to a teaching or suggestion of a method of extreme pressure lubrication

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<sup>4</sup>The rheostat is adjusted to “give 60 rpm with a load of 150 in-lb.” Clark, col. 7, ll. 22-23. And, Clark gives the resulting “lubricity coefficient” for the various lubricants. Clark, col. 7, Table I.

in Chesser. The examiner does not point to anything in Chesser that would motivate a PHOSITA to provide Clark's fluids with a "**continuous phase comprising as an integral component a dispersion comprising a quantity of *insoluble fatty acid soap particles comprising alkali metal.***" Claim 193. The examiner certainly does not point to anything in Chesser that would give a PHOSITA a reasonable expectation that, if selected, alkali metal derivatives of Clark's naturally occurring fats and oils would "**react . . . with one or more metal surfaces of drilling equipment**" and produce a lubricating film which provides effective lubrication to metal surfaces subject to friction **even under extreme pressure testing conditions.** Claim 193.

As seen from the foregoing, the examiner **has not met the flexible TSM test** with respect to claims 193-221. *Ortho-McNeil Pharmaceutical, Inc. v. Mylan Laboratories, Inc.*, 86 U.S.P.Q.2d at 1201-02 (emphasis added). The examiner has not established that claims 193-221 are directed merely to "**the predictable use of prior art elements according to their established functions,**" *KSR Int'l Co. v. Teleflex Inc.*, 82 U.S.P.Q.2d at 1396 (emphasis added). Nor has the examiner established an **apparent reason to combine known elements** in the fashion of claims 193-221. *Id.* (emphasis added).

### **3. The Examiner has not Met Her Burden to Establish Inherency**

Rather than pointing to a teaching, suggestion, motivation, or other initiative to combine known elements in the fashion claimed, the examiner contends that the limitations of the claims would be inherent in Clark if a PHOSITA selected alkali metal derivatives of Clark's naturally occurring fatty acids.

The rejection based on inherency should be reversed because the examiner has not met her burden to establish that "the missing descriptive matter is necessarily present in the thing described in [Clark and/or Chesser], and that it would be recognized by persons of ordinary skill." [Citations omitted.] *In re Robertson*, 49 U.S.P.Q.2d 1949, 1951 (Fed. Cir. 1999). Inherency "may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient." *Id.*, citations omitted. "[A] retrospective view of inherency is not a substitute for some teaching or suggestion supporting an obviousness rejection." *In re Rijckaert*, 9 F.3d 1531, 1533-34, 28 U.S.P.Q.2d 1955, 1957 (Fed. Cir. 1998).

Appellant respectfully requests the Board to reverse the rejection of all of claims 193-221 as obvious over Clark in view of Chesser.

**B. CLAIMS 202-210 AND 218-221**

Claim 202 specifies that the drilling fluid system comprises “one or more polymers comprising one or more monomers comprising acrylamide.” The examiner contends that claims 202-210 and 218-221 are obvious over Clark in view of Chesser, which is said to teach “that drilling fluid systems conventionally contain acrylamide monomers.” Final action mailed December 15, 2008, p. 2.

The Otto Decl. establishes that, in fluids containing such polymers, the prior art EP lubricant “LUBRI-FILM” created “an abnormal increase in mud viscosity.” Otto Decl., ¶ 9. The examiner does not point to any teaching or suggestion in Clark or in Chesser of this viscosification problem. The examiner does not point to any teaching or suggestion in Clark or in Chesser that the viscosification problem could be solved by using insoluble fatty acid soap particles comprising alkali metal as an EP lubricant. The examiner does not point to any teaching or suggestion of a reasonable expectation that effective rheology and fluid loss control properties could be maintained in a drilling fluid system comprising both insoluble fatty acid soap particles comprising alkali metal and the claimed polymer.

For the foregoing additional reasons, the examiner **has not met the flexible TSM test** with respect to claims 202-210 and 218-221. *Ortho-McNeil Pharmaceutical, Inc. v. Mylan Laboratories, Inc.*, 86 U.S.P.Q.2d at 1201-02 (emphasis added). The examiner has not established that claim 202-210 and 218-221 are directed merely to “the **predictable use of prior art elements according to their established functions**,” *KSR Int’l Co. v. Teleflex Inc.*, 82 U.S.P.Q.2d at 1396 (emphasis added). Nor has the examiner established an **apparent reason to combine known elements** in the fashion of claims 202-210 or 218-221. *Id.* (emphasis added).

Appellant respectfully requests the Board to reverse the rejection of claims 202-210 and 218-221 as obvious Clark in view of Chesser for these additional reasons.

### C. CLAIMS 197-201 AND 211-221

Claim 197 specifies the use of a drilling fluid system comprising “insoluble lithium fatty acid soap particles.” Claim 211 specifies the use of a drilling fluid system comprising “insoluble lithium stearate particles.”

The examiner has not pointed to any teaching or suggestion in any reference of a method using “insoluble **lithium** fatty acid soap particles” in the continuous phase of a drilling fluid for any particular reason. The examiner certainly has not pointed to any teaching or suggestion specifically to use insoluble **lithium stearate** particles in the continuous phase of a drilling fluid in order to provide extreme pressure lubrication. Claims 211-221.

For these additional reasons, the examiner **has not met the flexible TSM test** with respect to claims 197-201 and 211-221. *Ortho-McNeil Pharmaceutical, Inc. v. Mylan Laboratories, Inc.*, 86 U.S.P.Q.2d at 1201-02 (emphasis added). The examiner has not established that claim 197-201 and 211-221 are directed merely to “the **predictable use of prior art elements according to their established functions**,” *KSR Int’l Co. v. Teleflex Inc.*, 82 U.S.P.Q.2d at 1396 (emphasis added). Nor has the examiner established an **apparent reason to combine known elements** in the fashion of claims 197-201 or 211-221. *Id.* (emphasis added).

Appellant respectfully requests that the rejection of claims 197-201 and 211-221 be reversed for this additional reason.

### IV. CONCLUSION

As seen from the foregoing:

1. Drilling equipment requires several different types of lubrication depending upon conditions during drilling operations.
2. One type of lubrication needed by drilling equipment, called friction reduction, reduces the coefficient of friction at metal surfaces under relatively low pressures and loads.
3. Friction reducers promote efficiency when drilling operations require moderate reductions in drag or torque, and are evaluated in the laboratory at spindle speeds of about 60 rpm and pressures of about 150 in-lb or less.
4. Friction reducers are not designed to react with the metal surface of equipment to produce a coherent lubricating film.

5. Another type of lubrication, known as “extreme pressure” lubrication, reduces the occurrence of metal-to-metal (or metal-on-rock) seizure at higher pressures and loads.
6. Extreme pressure lubricants are designed to react with the metal surfaces of drilling equipment to provide a coherent lubricating film effective to reduce the occurrence of metal-to-metal (or metal-on-rock) contact and seizure at higher pressures and loads.
7. There are two different tests for friction reduction and extreme pressure lubrication.
8. In the past, extreme pressure lubricants generally comprised fatty acid soaps of metals having a relatively high valence, such as aluminum.
9. Most current drilling fluid systems comprise polymeric materials which tend to react with metals having valences greater than 1.
10. Reaction between the polymeric material in a drilling fluid system and a high valence metal in a fatty acid soap adversely affects drilling fluid properties.
11. The examiner has not established that Clark teaches or suggests a method of extreme pressure lubrication.
12. Clark describes “an oil-in-water emulsion well fluid, with oil or hydrophobic phase, and a water phase” wherein “the base fluid is water . . . . [and] the oil-phase of the oil-in-water well fluid . . . may include any non-water soluble material that will provide the required rate of penetration or lubrication . . . [including] naturally occurring fats and oils.” Clark, col. 4, ll. 45-58 (emphasis added).
13. Clark describes a variety of suitable naturally occurring fats and oils suitable for use as the internal “oil phase” in Clark’s fluid.
14. Clark also states that:

Derivatives of the above described fatty acids may also be utilized in the present invention. Such derivatives include alkali, alkaline earth, or transition metal substituted fatty acids; oxidized fatty acids; amides of fatty acids; salts of fatty acids; esters of fatty acids; sulfated fatty acids; sulfonated fatty acids; alkoxylated fatty acids; phosphatized fatty acids; and mixtures thereof.

Clark, col. 5, ll. 56-62 (emphasis added).

15. Based on the teachings of Clark, a PHOSITA would select liquid derivatives of Clark’s naturally occurring fats and oils for use as Clark’s oil phase.
16. The examiner has not established that a PHOSITA would have been motivated to provide Clark’s fluids with a “continuous phase comprising as an integral component a dispersion

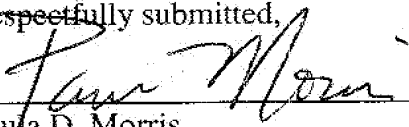
comprising a quantity of insoluble fatty acid soap particles comprising alkali metal.”

Claim 193. See also claims 197, 202, and 211.

17. The examiner has not established that PHOSITA would have a reasonable expectation that, if selected, the alkali metal derivatives of Clark’s “naturally occurring fats and oils” would “react . . . with one or more metal surfaces of drilling equipment” to produce a lubricating film which provides effective lubrication to metal surfaces subject to friction even under extreme pressure testing conditions.
18. This conclusion is supported by Clark’s Example 1, in which a low load, low pressure lubricity test is performed.
19. The examiner has not pointed to a teaching or suggestion in Clark or in Chesser of every limitation of the claimed method.
20. The examiner has not established that the missing descriptive matter is necessarily present in Clark and/or Chesser, and that it would be recognized by a PHOSITA.
21. The Otto Decl. establishes that, in fluids containing polymers comprising one or more monomers comprising acrylamide, the prior art EP lubricant “LUBRI-FILM” created “an abnormal increase in mud viscosity.” Otto Decl., ¶ 9.
22. The examiner has not pointed to a teaching or suggestion in Clark or in Chesser to reduce an abnormal increase in mud viscosity by using EP lubricant comprising insoluble fatty acid soap particles comprising alkali metal.
23. The examiner has not established that a PHOSITA would have had a reasonable expectation that effective rheology and fluid loss control properties could be maintained in a drilling fluid system comprising polymers comprising one or more monomers comprising acrylamide and insoluble fatty acid soap particles comprising alkali metal.
24. The examiner has not pointed to a teaching or suggestion in Clark or in Chesser of a method using “insoluble lithium fatty acid soap particles” in the continuous phase of a drilling fluid for any particular reason. Claims 197-201.
25. The examiner has not pointed to any teaching or suggestion in Clark or in Chesser to use insoluble lithium stearate particles in the continuous phase of a drilling fluid for any particular reason. Claims 211-221.
26. U.S. Patent No. 3,047,494 to Browning (“Browning”) would have taught a PHOSITA to use EP lubricants comprising metal soaps of fatty acids other than alkali metals.

For all of the foregoing reasons, Appellant respectfully requests that the rejection be REVERSED. The Commissioner is hereby authorized to charge any fees in connection with this paper, or to credit any overpayment, to Deposit Account No. 02-0429 (154-28553-US), maintained by Baker Hughes Incorporated

Respectfully submitted,



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**BOARD OF PATENT APPEALS AND INTERFERENCES  
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

<b>In re Application of:</b>	§	<b>Group Art Unit: 1797</b>
<b>OTTO, et al.</b>	§	
	§	
<b>Serial No.: 10/792,056</b>	§	
	§	<b>Examiner: Ellen M. McAvoy</b>
<b>Filed: March 3, 2004</b>	§	
	§	
<b>For: Method for Lubricating and/or</b>	§	<b>Atty. Docket: 154-28553-US</b>
<b>Reducing Corrosion of Drilling</b>	§	
<b>Equipment</b>	§	

**CLAIMS APPENDIX**

193. A method of providing extreme pressure lubrication of drilling equipment during drilling operations, the method comprising:

providing a drilling fluid system having effective rheology and fluid loss control properties, the drilling fluid system comprising a continuous phase comprising as an integral component a dispersion comprising a quantity of insoluble fatty acid soap particles comprising alkali metal selected from the group consisting of lithium, potassium, rubidium, cesium, and combinations thereof; and,

drilling through a subterranean formation using the drilling fluid system under conditions effective to maintain effective rheological properties and gel strengths and to maintain effective fluid loss control properties, and to react the insoluble fatty acid soap particles with one or more metal surfaces of drilling equipment in contact with the drilling fluid system, thereby producing lubricated drilling equipment comprising one or more metal surface comprising a substantially continuous lubricating film providing improved lubricity as reflected in an increase in lubricating film strength compared to a control during extreme pressure testing.

194. The method of claim 193 wherein the improved lubricity comprises an increase of 25% or more in lubricating film strength, measured in psi, compared to a control during extreme pressure testing.

195. The method of claim 193 wherein the dispersion remains thermally stable when the conditions comprise a temperature of 250 °F (121 °C).

196. The method of claim 193 wherein the dispersion remains thermally stable when the conditions comprise a temperature of 450 °F (232 °C).

197. A method of providing extreme pressure lubrication of drilling equipment during drilling operations, the method comprising:

providing a drilling fluid system having effective rheology and fluid loss control

properties, the drilling fluid system comprising a continuous phase comprising as an integral component a dispersion comprising a quantity of insoluble lithium fatty acid soap particles; and,

drilling through a subterranean formation using the drilling fluid system under conditions effective to maintain effective rheological properties and gel strengths and to maintain effective fluid loss control properties, and to react the insoluble lithium fatty acid soap particles with one or more metal surfaces of drilling equipment in contact with the drilling fluid system, thereby producing lubricated drilling equipment comprising one or more metal surface comprising a substantially continuous lubricating film providing improved lubricity as reflected in an increase in lubricating film strength compared to a control during extreme pressure testing.

198. The method of claim 197 wherein the improved lubricity comprises an increase of 25% or more in lubricating film strength, measured in psi, compared to a control during extreme pressure testing.

199. The method of claim 198 wherein the dispersion remains thermally stable when the conditions comprise a temperature of 250 °F (121 °C).

200. The method of claim 198 wherein the dispersion remains thermally stable when the conditions comprise a temperature of 450 °F (232 °C).

201. The method of claim 198 wherein the drilling fluid system comprises an aqueous continuous phase.

202. A method of providing extreme pressure lubrication of drilling equipment during drilling operations, the method comprising:

providing a drilling fluid system having effective rheology and fluid loss control properties, the drilling fluid system comprising one or more polymers comprising one or more monomers comprising acrylamide and a continuous phase comprising as an integral component a dispersion comprising a quantity of insoluble fatty acid soap particles comprising alkali metal selected from the group consisting of lithium, potassium, rubidium, cesium, and combinations thereof, drilling through a subterranean formation using the drilling fluid system under conditions effective to maintain effective rheological properties and gel strengths and to maintain effective fluid loss control properties, and to react the insoluble fatty acid soap particles with one or more metal surfaces of drilling equipment in contact with the drilling fluid system, thereby producing lubricated drilling equipment comprising one or more metal surface comprising a substantially continuous lubricating film providing improved lubricity, as reflected in an increase in lubricating film strength compared to a control during extreme pressure testing.

203. The method of claim 202 wherein the improved lubricity is demonstrated by an increase of 25% or more in lubricating film strength, measured in psi, compared to a control during extreme pressure testing.

204. The method of claim 203 wherein the continuous phase is aqueous.

205. The method of claim 203 wherein the alkali metal is lithium.

206. The method of claim 204 wherein the alkali metal is lithium.

207. The method of claim 203 wherein the dispersion remains thermally stable when the conditions comprise a temperature of 250 °F (121 °C).

208. The method of claim 203 wherein the dispersion remains thermally stable when the conditions comprise a temperature of 450 °F (232 °C).

209. The method of claim 203 wherein the polymer comprises a combination of one or more acrylamide alkyl alkane sulfonate monomers and one or more dialkyl acrylamide monomers.

210. The method of claim 203 wherein the polymer comprises a combination of acrylamide methyl propane sulfonate (AMPS) and dimethyl acryamide (DMA).

211. A method of providing extreme pressure lubrication of drilling equipment during drilling operations, the method comprising:

- providing a drilling fluid system having effective rheology and fluid loss control properties, the drilling fluid system comprising a continuous phase comprising a dispersion comprising a quantity of insoluble lithium stearate particles, drilling through a subterranean formation using the drilling fluid system under conditions effective to maintain effective rheological properties and gel strengths and to maintain effective fluid loss control properties, and to react the insoluble lithium stearate particles with one or more metal surfaces of drilling equipment in contact with the drilling fluid system, thereby producing lubricated drilling equipment comprising one or more metal surface comprising a substantially continuous lubricating film providing improved lubricity as reflected in an increase in lubricating film strength compared to a control during extreme pressure testing.
212. The method of claim 211 wherein the improved lubricity is demonstrated by an increase of 25% or more in lubricating film strength, measured in psi, compared to a control during extreme pressure testing.
213. The method of claim 212 wherein the continuous phase is aqueous.
214. The method of claim 212 wherein the dispersion remains thermally stable when the conditions comprise a temperature of 250 °F (121 °C).
215. The method of claim 212 wherein the dispersion remains thermally stable when the conditions comprise a temperature of 450 °F (232 °C).
216. The method of claim 213 wherein the dispersion remains thermally stable when the conditions comprise a temperature of 250 °F (121 °C).
217. The method of claim 213 wherein the dispersion remains thermally stable when the conditions comprise a temperature of 450 °F (232 °C).
218. The method of claim 212 further comprising providing the drilling fluid system with one or more polymers comprising acrylamide monomers while maintaining the effective rheological properties, gel strengths, and fluid loss control properties.
219. The method of claim 218 wherein the polymer comprises a combination of one or more acrylamide alkyl alkane sulfonate monomers and one or more dialkyl acrylamide monomers.
220. The method of claim 218 wherein the polymer comprises a combination of AMPS and DMA.

221. The method of claim 212 wherein the substantially continuous lubricating film reduces corrosion of the one or more metal surface.

**BOARD OF PATENT APPEALS AND INTERFERENCES  
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<b>OTTO, et al.</b>	§	
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<b>Serial No.: 10/792,056</b>	§	
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<b>Reducing Corrosion of Drilling</b>	§	
<b>Equipment</b>	§	

**EVIDENCE APPENDIX**

Exhibit A: Declaration of Michael Otto under 37 C.F.R. § 1.132.  
Exhibit B: "Model 212 EP/Lubricity Tester Instruction Manual."

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

<b>Applicant:</b>	<b>OTTO, et al.</b>	<b>§</b>	<b>Group Art Unit:</b>	<b>1764</b>
<b>Serial No.:</b>	<b>10/792,056</b>	<b>§</b>	<b>Examiner:</b>	<b>Ellen M. McAvoy</b>
<b>Filed:</b>	<b>03/03/2004</b>	<b>§</b>	<b>Atty. Docket No.:</b>	<b>154-28553-US</b>
<b>Title:</b>	<b>Method for Lubricating and/or Reducing Corrosion of Drilling Equipment</b>			

**DECLARATION OF MICHAEL OTTO UNDER 37 C.F.R. § 1.132**

I, MICHAEL OTTO, declare as follows:

1. I am an inventor in the referenced application. All statements made herein of my own knowledge are true and all statements made on information and belief are believed to be true.
2. I have worked in the oil services industry for almost 34 years. During the past 31 years, I have worked for Baker Hughes Drilling Fluids (and its predecessors, hereafter collectively referred to as "BHDF") in Houston, Texas.
3. My work for BHDF has included product development, research and development, and technical support. I am currently a Senior Technical Advisor at BHDF.
4. During the early 1980's, I was working with a BHDF customer on location in the Imperial Valley of California.
5. At least some of the wells drilled by the BHDF customer in the Imperial Valley were geothermal wells. Geothermal wells can have extremely high bottom hole temperatures (in excess of 500° F).
6. The mud systems used by BHDF to drill geothermal wells in the Imperial Valley during the 1980's comprised high temperature acrylamide based copolymers.
7. While drilling one geothermal well using a BHDF high temperature, copolymer mud system comprising acrylamide copolymer, the mud system was treated with a high temperature, extreme pressure lubricant called "LUBRI-FILM."
8. LUBRI-FILM is an aluminum stearate/lignosulfonate dispersant.

9. The mud system treated with LUBRI-FILM exhibited reduced torque and drag, but also exhibited an abnormal increase in mud viscosity.

10. The abnormal increase in viscosity was believed to be partially due to a solids build up in the mud system. In order to resolve the solids build-up problem, a large portion of the mud system was displaced with new drilling fluid, producing conditioned mud.

11. The conditioned mud was subjected to pilot testing on location at elevated temperatures to evaluate the effect of LUBRI-FILM on the conditioned mud. No abnormal viscosification was observed during the on site pilot testing.

12. Based on the successful pilot test, a minimal treatment of approximately 1 ppb of the LUBRI-FILM was added to the mud system.

13. Within 48 hours after adding the 1 ppb of LUBRI-FILM to the mud system, routine product additions could not be made to the mud system due to the occurrence of abnormal viscosity/abnormal gel strength.

14. All product additions to the mud system were stopped for a period of days to determine what, if any, products could be added to the conditioned fluid.

15. A decision was made to stop using LUBRI-FILM in mud systems comprising acrylamide based polymers and copolymers. This decision was made even though the operator and rig personnel were impressed with the performance of LUBRI-FILM and with its bluing effect on the drill pipe.

16. The need remained for an extreme pressure lubricant that could be used to treat high temperature mud systems comprising acrylamide based polymers and copolymers.

17. I hypothesized that a monovalent fatty acid lubricant might provide extreme pressure lubrication and bluing of the drill pipe without causing an abnormal increase in viscosity.

18. In the early 1990's, I prepared a lithium stearate lubricant and tested it in the BHDF lab using a customer's field mud.

19. The lithium stearate lubricant reacted with and "blued" the metal surfaces to which it was exposed, as seen in the Examples and Figures.

20. The lithium stearate did not cause abnormal viscosification-- even in the presence of PYRO-TROL<sup>®</sup>, an acrylamide (AM), 2-amino-2-methyl propane sulfonic acid (AMPS) copolymer additive.

(Exhibit A)

21. I did not know before the laboratory evaluation whether lithium stearate would react with and blue metal surfaces.

22. In my opinion, other monovalent alkali metals would produce similar results. I understand that willful false statements and the like are punishable by fine or imprisonment, or both (18 U.S.C. 1001) and may jeopardize the validity of the application of any patent issuing thereon.

SIGNED this 13 day of February, 2009.

  
MICHAEL OTTO

(Exhibit A)

**Model 212 EP/Lubricity Tester  
Instruction Manual**

Part No. 211210001EA

Rev. D

**(Exhibit B)**

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(Exhibit B)

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(Exhibit B)

## SECTION 1 GENERAL INFORMATION

Manifestation of friction between the drill string and the borehole is as old as drilling itself. Frictional resistance to rotation of the drill string is called torque, and frictional resistance to hoisting and lowering the drill string is called drag. Many different materials have been used as drilling fluid additives to improve lubricity, thereby reducing friction. Bentonite (AQUAGEL)®, graphite, asphalt, diesel, crude oils, fine mica, ground nut hulls, TORQ-TRIM II®, EP MUD LUBE®, and LUBRA-BEADS® are some examples of these additives. The lubricity, or drill string to bore hole wall drag, of drilling fluid is a property of special importance in drilling directional wells. An increase in friction between drill string and borehole is expected when drilling a hole off-vertical. Most of the wells drilled from fixed platforms offshore are completed in deviated holes. Desirable characteristics of a lubricant for this purpose, aside from the obvious requirement of performing well as a lubricant, are that it is non-toxic and bio-degradable, and does not form an oily slick on water. Since evaluation of the various lubricating materials in the various types and quality of drilling fluid cannot realistically be done on the drilling rig, a functional (drilling fluid lubricity) test was designed to simulate the torque and drag produced by a given drilling fluid downhole. The tester models or approximates the speed of rotation of the drill pipe and the pressure with which the pipe bears against the wall of the hole where the friction is generated.

Extreme pressure lubricants (EP MUD LUBE) have been developed to increase the life of bit-bearings. Extreme pressure lubrication deals with metal surfaces in rubbing contact with each other at very high pressures (eg., 30,000 to 100,000 psi (206,820 to 689,400 kPa)). Lubrication for the metal surfaces is provided by a pressure resistant film that is produced as a result of the chemical reaction initiated by a high temperature generated from friction at the area of contact.

The combination EP (Extreme Pressure) and Lubricity Tester (Fig. 2) is a high-quality instrument designed to measure the lubricating quality of drilling fluids, provide data to evaluate the type and quantity of lubricating additives that may be required, and predict wear rates of mechanical parts in known fluid systems.

The EP tests (Fig. 1) are performed by applying a measured force with a torque arm to a torque-sensitive, rotating bearing cup. This provides a means of testing lubrication under extreme pressure conditions and produces an indication of the film strength of the fluid being tested. The problem of reduction of friction between the drill string and the borehole requires a different simulation. The more common lubricity test (Fig. 1) measures fluid resistance (lubricating character) between two hardened steel moving surfaces at a hundred pounds force (which translates into a 5,000 to 10,000 psi (34,470 to 68,940 kPa) pressure on the intermediate fluid film). During the lubricity test, a steel block is pressed against a rotating steel ring. Load in inch-pounds is read directly from the dial on the torque arm.

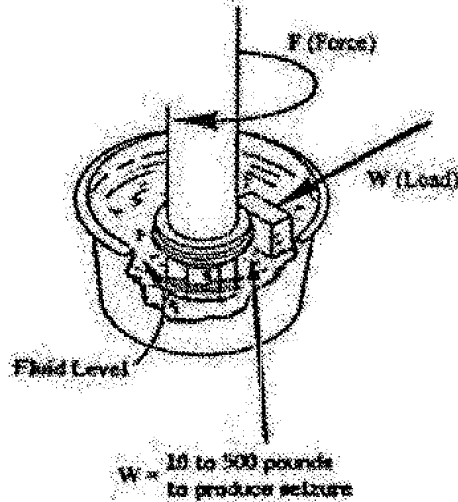
Measure of friction is a requirement for the determination of the film strength of a lubricant, for bit bearing wear, as is obtained in EP test and for the determination of torque or drag of the drill pipe as determined in the lubricity test.

Friction is measured as the coefficient of friction ( $\mu$ ). The coefficient of friction ( $\mu$ ) between two solids is defined as  $F/W$ , where  $F$  denotes the frictional force and  $W$  is the load or force perpendicular to the surfaces.

Thus, the coefficient of friction is independent of the apparent area of contact as long as this area is not so small as to break through the film; that is, with the same load  $W$ , the force to overcome friction will be the same for a small area as for a larger area. Applied to the Lubricity Tester, the load is the force with which the test block is pressed against the test ring through the torque arm. The force  $F$  required to slide the block and ring surfaces across each other at a given rate is measured by the power required to turn the test ring at a prescribed number of revolutions per minute. The coefficient of friction,  $\mu = F/W$ . Refer to Figure 1.

(Exhibit B)

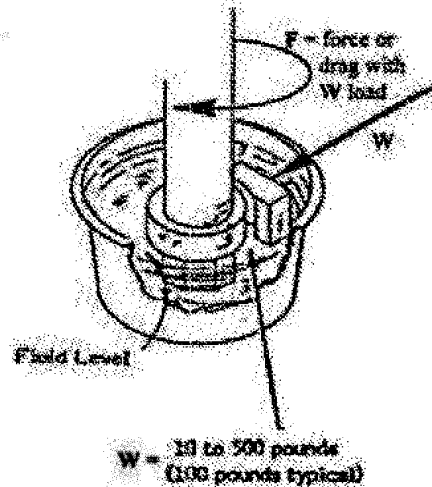
**EP (Extreme Pressure Lubricity/  
Film Strength Test)**



Usually higher shear rate 1000 RPM for EP test.

Here fluid pressures run from 5,000 to 100,000 psi between surfaces. The pressure (force) at various speeds at which film breaks and galling occurs can be measured and improved additives tested.

**Lubricity (Surface to Surface  
Drag Test)**



100 psi @ 60 RPM for standard lubricity coefficient test.

Lubricity additives to lessen drag losses can be easily tested. The wear on a part can be predicted by making block or both ring and block of material used in part, and running in fluid expected in application. The procedure for this test is described in API procedure RP138, as well as in this instruction.

**Fig. 1 - COMPARISON OF EP AND LUBRICITY TEST**

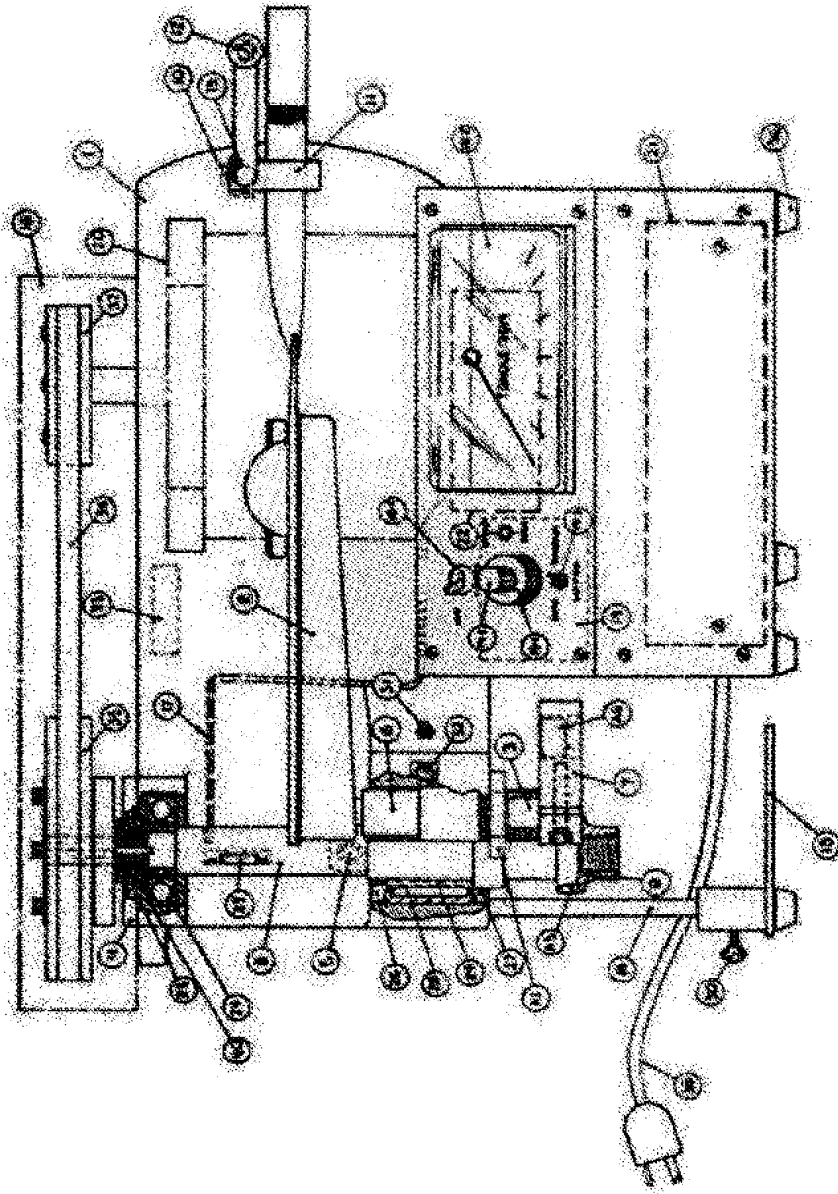
(Exhibit B)

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**(Exhibit B)**



**Fig. 2 - EP/LUBRICITY TESTER**

**(Exhibit B)**

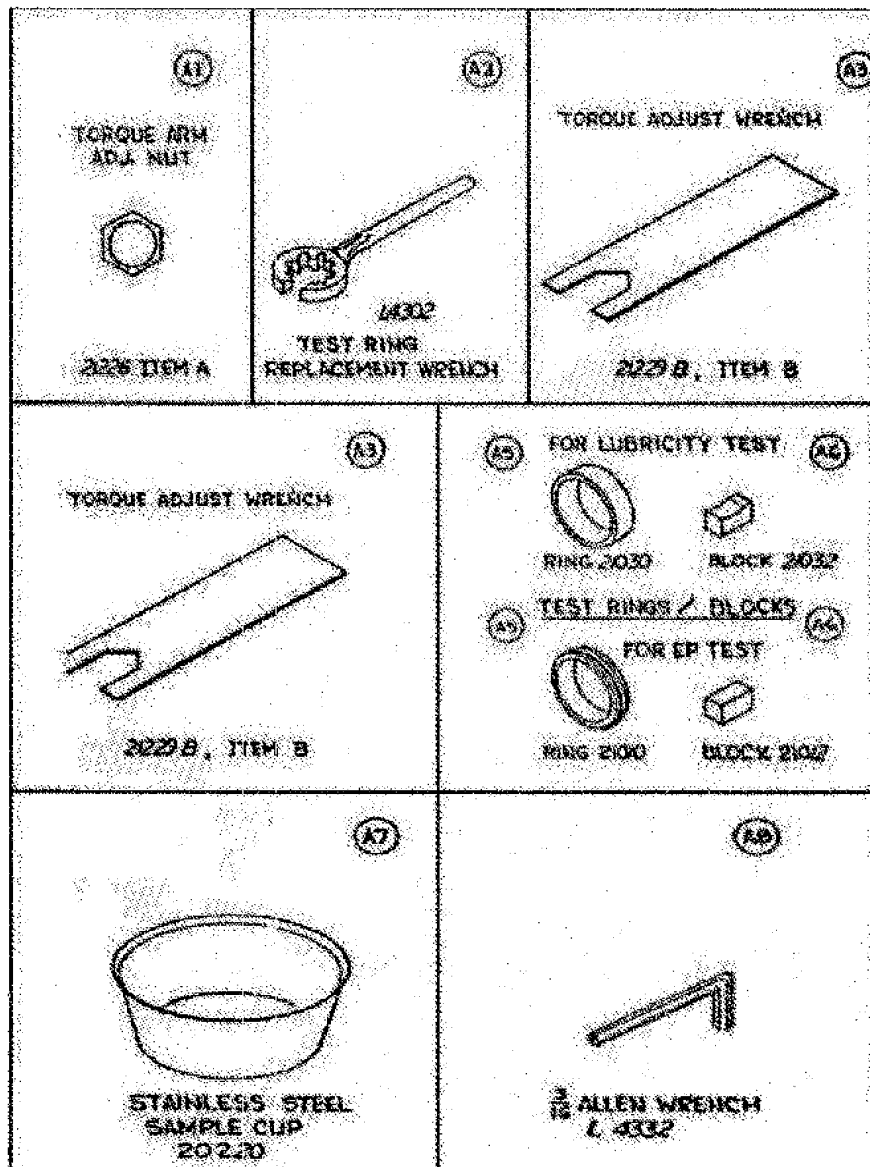


Fig. 3 - ACCESSORIES

(Exhibit B)

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**(Exhibit B)**

## SECTION 2 SAFETY CONSIDERATIONS

### A. SAFE OPERATION

The safe operation of the EP/Lubricity Tester requires that the laboratory technician be familiar with the proper operating procedures and the potential hazards associated with the equipment. This machine is driven by a 115 volt electric motor connected by a "V" belt drive to the main shaft assembly. The machine is equipped with a belt guard to afford some protection, however care should be exercised to keep hands, clothes, and other objects clear of all rotating parts. Do not put hands or fingers in or near the sample cup, test block or test ring while the machine is running. Use caution immediately after stopping it because under some test conditions these parts may get hot enough to cause burns.

Make sure the machine is unplugged when cleaning or moving it. Be sure it is unplugged when wiping the bench around or under it. Do not allow the panel containing the meter get wet. If test fluid or water is spilled on it, wipe clean with a damp cloth. Excessive water could cause damage to the electrical components on the under side of the panel and could also be an electrical shock hazard.

### B. SAFETY PRECAUTIONS DURING CALIBRATION

Calibration procedures are described in Section 7. Sec. 7-A procedure will determine if it is necessary to partially dis-assemble the machine for a complete calibration.

PROCEDURES OF SEC. 7 C THROUGH E INVOLVES OPERATING THE MACHINE WITH THE BELT GUARD REMOVED AND ITS CONTROL PANEL REMOVED WHICH EXPOSES, UNPROTECTED, HIGH VOLTAGE TERMINALS. TOUCHING OR ALLOWING THESE TERMINALS TO TOUCH THE MACHINE OR WORK SURFACE CAN CAUSE DAMAGE AND INJURY. ALSO THE PONY BRAKE IS A DYNAMIC BRAKING TOOL WHICH, IF NOT HANDLED CAREFULLY, CAN GRAB ONTO SHAFT AND SWING UPWARDS TOWARDS OPERATOR'S JAW WHILE DROPPING 1000 GRAM WEIGHT ON FOOT.

This procedure should be carefully studied and a "DRY RUN" made with the machine unplugged to become familiar with where moving parts will be, where exposed electrical connections are, and where the adjustment potentiometers are located so that neither the technician nor the machine is injured by these potential hazards. Make sure to unplug the machine before re-assembly.

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(Exhibit B)

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**(Exhibit B)**

## SECTION 3 LUBRICITY RING - BLOCK PAIRS

### A. INTRODUCTION

Variations in the Martensite structure of the steel in the lubricity ring and block can cause non-standard readings on calibrated Lubricity Testers. The following data provides the user of a lubricity tester the necessary starting point for use of known calibrated pairs in dynamic-friction-with-fluid-film-interface or "lubricity co-efficient" testing. This ring-block pair was "worn in" and calibrated on a calibrated Lubricity Tester.

### B. PROCEDURE

Verify the alignment of the eccentric bushing up or down and in or out, with ring-block submerged in water so that wear pattern being generated is in the center of the shiny portion of the block. Operate pair in distilled water for at least 15 minutes before taking any data at standard condition (60 rpms and 150 in. - lbs. (16.95 n·m)). This must be done as a new pattern will develop over the old one when a pair is moved to another tester, as no two machines will have exactly the same geometry. If adjustments are required, refer to Section 4, Parts A and B for Lubricity (in or out), and Section 4, Parts A and B for EP (up or down). After using pairs for testing slurries, periodically return to water to be certain of trend of pair, or to be confident that a migration of 3 - 4 units has not occurred.

Life of a pair is determined by wear depth. Measure the OD of ring when new and note that when 0.025 in. (.635 mm) has been worn from case hardened surface (0.050 on the OD), then the ring is devoid of consistent case hardening and will not produce reasonable readings. Block life should never extend beyond a 0.1 inch (2.54 mm) wear depth. As the pair ages, new calibration data can be inserted on this sheet at any time to ensure user confidence in the data produced by the pair.

$$\text{Correction Factor (CF)} = \frac{34}{(\text{AV. READING})}$$

$$\text{Lubricity Coefficient} = \frac{\text{Meter Reading} \times (\text{CF})}{100}$$

(Exhibit B)

CALIBRATION CHECK						
	RUN 1			RUN 2		
	TIME	READING	TEMP. °F/°C	TIME	READING	TEMP. °F/°C
STARTING						
30 MIN.						
40 MIN.						
50 MIN.						
60 MIN.						
70 MIN.						
AVERAGE READING						

**Fig. 4 - LUBRICITY RING BLOCK PAIRS**

**(Exhibit B)**

## SECTION 4 LUBRICITY TEST

*(Refer to Figs. 3 & 4)*

### A. BLOCK AND RING STANDARDIZING TEST

The coefficient of friction value for water would be 34 at 60 RPM and 150 inch-pounds (16.95 N·m) force, if all ring-block metallurgical structures were the same. However, since they are not, a correction factor of 34 divided by the water reading is used. A convenient form for this purpose is shown in Fig. 4.

1. Clean test ring (A5 with flat surface) and test block (A6 with indented surface) with a cleaner such as Ajax® or Comet® with chlorinal, and rinse thoroughly with water. Before starting the test, all parts of machine in sample area must be clean. This includes the stainless steel cup (A7), exposed portion of bushing (3), cup retainer nut (9), block holder (7), and lower part of shaft (8).

#### CAUTION

CONTAMINATION CAN CAUSE INCORRECT TEST RESULTS.  
AVOID TOUCHING THE OUTSIDE OF TEST RING.

2. Place lubricity test ring on main shaft (8) and, using wrench (A2), secure with test ring retainer nut (9). Engage shaft lock plunger in hole in shaft to prevent shaft rotation while retainer nut is tightened. Make sure the ring seats squarely on the taper of the shaft.
3. Place lubricity test block in block holder with indentation towards main shaft away from torque shaft (Refer to Fig. 2).
4. With meter switch (19-3) in RPM position, turn power switch (18-1) to "ON". Let machine run approximately 15 minutes.
5. Rotate speed control knob (19-1) counterclockwise until the Torque/RPM meter (18-2) registers 60 RPM.
6. Turn meter switch to TORQUE. Turn torque/zero adjustment knob (19-2) until torque registers zero. Turn off machine.
7. Fill stainless steel sample cup (A7) with distilled water. Place on lowered cup stand (15). Raise cup stand until ring is submerged. Secure with thumb screw (30).
8. Release the torque adjust handle, turning it counterclockwise, as far as is necessary, then position torque wrench handle (2) so that it fits inside concave portion of torque arm clamp (10).
9. Start machine and let it run approximately 5 minutes, then recheck RPM and torque, as in steps 5 and 6.
10. With meter switch in TORQUE position, rotate torque adjust handle (12) clockwise to apply 150 inch-pounds (16.95 N·m) of torque. Let machine run 4 to 5 minutes.

**(Exhibit B)**

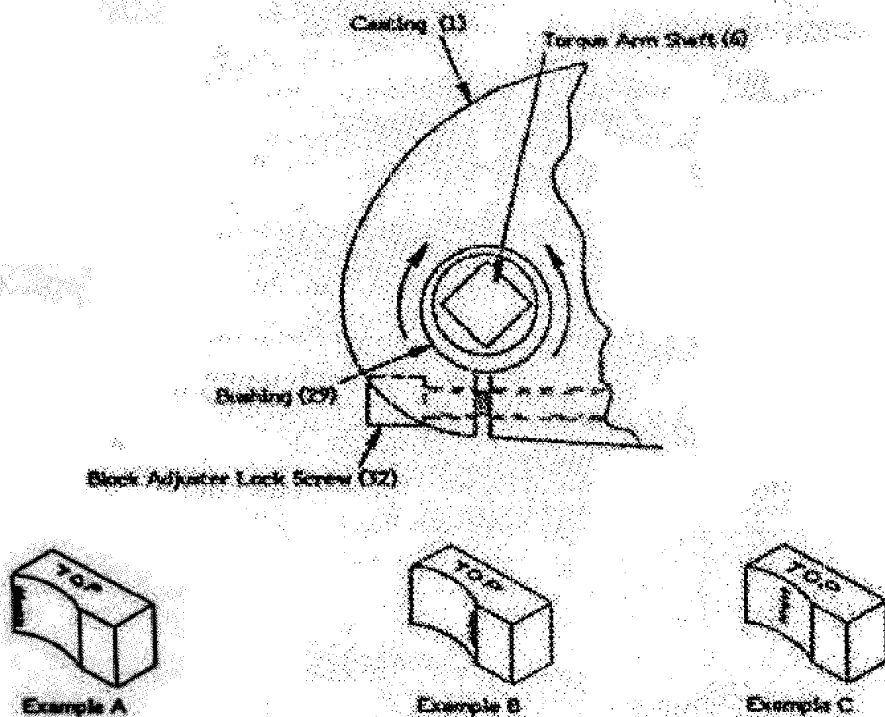
11. A ring-block pair calibration sheet (Fig. 4) with water readings is supplied with each new machine. Compare torque reading to this Average value in the range of between 28 and 48 and steady within  $\pm 3$ . If the ring-block surfaces are smooth and a record is available, proceed to C - "LUBRICITY MEASUREMENT OF TEST SAMPLE" and D - "SAMPLE LUBRICITY CALCULATIONS", otherwise; the block and ring must be calibrated using the procedure of B - "STANDARDIZING BLOCK AND RING". A blank form, as illustrated in Fig. 4, should be used.

## B. STANDARDIZING BLOCK AND RING

If the coefficient of friction value for water is not in the proper range, or drifting excessively or a gritty sample has scoured surfaces, the ring and block surfaces must be reconditioned or standardized. If a block is standardized, it will have a substantial portion (at least 1/3) of its curved surface worn to a shine condition with a minimum of groove lines through this polished area, as seen in Fig. 5, Ex. C. Also a ring-block calibration data sheet should be filled out and maintained for the pair. When the ring and block are engaged in the following procedures, no new wear surfaces should appear and no unexpected results occur using the pair.

1. Check to ensure all surfaces are clean and that the wear surface is in the middle, or just forward, of curvature on the block (Refer to Fig. 4 Ex. C). If an adjustment is required, follow the procedure given in Fig. 5.
2. Operate the machine at 100 to 200 RPM. If there is scouring, recondition the surfaces in water by applying fine valve grinding compound with finger to ring and applying 150 inch-pounds (16.95 N·m) of force. Remove torque after 5 minutes to reapply grinding compound on ring. Then reapply constant 150 inch-pounds (16.95 N·m) of force for 5 minutes. This procedure is repeated 3 to 4 times.
3. Use Ajax® or Comet® with chlorinal to remove grinding compound and grease, then rinse thoroughly. Mix 2 tablespoons of aluminum oxide powder into a cup of distilled water and submerge block and ring in this slurry.
4. Operate the instrument for 5 minutes at 700-1000 RPM, with 50 inch-pounds (5.65 N·m) force between ring and block, then reduce the force to 25 inch-pounds (2.83 N·m) for another 5 minutes.
5. Rotate torque adjust handle counterclockwise until torque handle can be released from torque arm clamp (10). Lower cup stand and discard fluid. Wipe fluid from sample cup, block, block holder, and ring.
6. Examine ring and block for shiny condition with a minimum of scars. If acceptable, retest block and ring standardization. Refer to Section 4-A "BLOCK AND RING STANDARDIZING TEST".
7. If an acceptable torque (28-48) steady ( $\pm 3$  units) reading is still not attained, check prony brake calibration of instrument. Refer to Section 6-E "PONY BRAKE TORQUE CALIBRATION".
8. Precalculated ring block pairs are available as Part No. 21034 with the correction factor already determined. Use of the precalibrated block and ring eliminates the procedures described above in Section 4-A "BLOCK AND RING STANDARDIZING" and Section 3-B "STANDARDIZING BLOCK AND RING" and allows check out of an instrument just as soon as the units eccentric bushing is adjusted to fit the blocks wear surface, if necessary (Refer to Fig. 5) for adjustment procedure.

(Exhibit B)



With block holder rotated to wear ring, note the eccentricity of shaft in hole. This figure shows the shaft left in hole. Loosen bushing adjuster lock screw (32) with a 3/16 allen wrench and rotate bushing (29) in hole counterclockwise to move block forward to correct for too much wear at tip (Example A), or clockwise to correct for too much wear at base of block (Example B). Retighten bushing adjuster lock screw. Repeat until wear is near center of curvature. (Example C).

**Fig. 5 - ADJUSTMENT FOR CURVATURE OF LUBRICITY TEST BLOCK**

(Exhibit B)

### C. LUBRICITY MEASUREMENT OF TEST SAMPLE

1. Mix sample fluid for 10 minutes. Be sure instrument is clean from previous tests or calibration procedures. Pour desired fluid into cup (A7). Place on lowered cup stand (15), then raise until block, block holder and test ring are immersed in fluid. Secure with thumb screw (30).
2. For standard test, set RPM's to 60 and be sure torque meter is zero with no load on torque wrench.
3. Apply 150 inch-pounds (16.95 N-m) of torque. Let machine run 3 to 5 minutes.
4. After 3 to 5 minutes, record torque reading. Then release torque.
5. Repeat steps 1-4, using an identical fluid sample with the desired lubricant added.
6. Turn power off. Lower cup stand. Turn torque arm clamp up and away, then swing torque arm back to allow removal of test block.
7. After completion of tests, remove and thoroughly rinse test block with water. Remove cup and discard fluid. Using cleanser, such as Ajax® or Comet® with chlorinal, rinse and clean main shaft, block holder, torque shaft, test ring, and nut.

### D. SAMPLE LUBRICITY CALCULATIONS

1. 
$$\text{Coefficient of friction} = \frac{\text{Torque Reading}}{100}$$

with the instrument set at 60 RPM and a pressure of 100 lbs.

That is: 
$$\frac{150 \text{ in-lbs. (Torque wrench reading)}}{1.5 \text{ inches (Torque shaft lever arm)}} = 100 \text{ lbs.}$$

2. **Correction Factor (F)**

= 
$$\frac{\text{Meter Reading for Water (Standard)}}{\text{Meter Reading obtained in water calibration}} = \frac{34}{\text{Meter Reading obtained (28 to 48)}}$$

3. 
$$\text{Lubricity coefficient} = \frac{\text{Meter Reading} \times \text{Correction Factor}}{100}$$

4. The percent torque reduction is based upon the torque reading of sample treated with a lubricant relative to the same sample untreated. A simple equation of this calculation may be written as follows:

$$\% \text{ Torque Reduction at a given load} = 1 - \frac{BL}{AL} \times 100$$

- a. BL = Torque reading of treated sample under a constant force.
- b. AL = Torque reading of untreated sample under same force.

(Exhibit B)

## SECTION 5

### EXTREME PRESSURE (EP) TEST

A test made with the EP/Lubricity Tester using the EP ring and block is a measure of the relative extreme pressure lubricating ability of a drilling fluid.

#### A. BLOCK AND RING ALIGNMENT TEST (Refer to Fig. 1 and 6)

Before a test can be run accurately, the machine must be in proper adjustment, as indicated by the rectangular shape in Fig. 6, Ex. C. To test for proper adjustment (or to do a standard test) proceed through steps 1 - 11. If alignment is a problem, go to B "BLOCK ALIGNMENT".

1. Clean EP test ring (A5 ring Part No. 21010, with narrow raised surface) and EP test block (A6 block Part No. 21012, with 6 flat surfaces) with a cleaner such as Ajax® or Comet® with chlorinal and rinse thoroughly with water. Before starting test, all parts of the machine in the sample area must be clean. These include the stainless steel sample cup (A7), exposed portion of bushing (3), test ring retainer nut (9), block holder (7), and lower part of shaft (8).
2. Install test ring squarely onto tapered portion of shaft (8). Then, using wrench (A2), secure with test ring retainer nut (9). Engage shaft lock plunger (5) in hole in shaft to prevent shaft rotation while retainer nut is tightened. (Refer to Fig. 1) Take care not to contaminate outside of test ring. Contamination by skin oil can cause inaccurate test results.
3. Place EP test block in block holder (7).
4. With meter switch (19-3) in RPM position, turn power switch (18-1) to "ON". Rotate speed control knob (19-1) clockwise or counterclockwise until torque/RPM meter (18-2) registers  $1000 \pm 100$  RPM.
5. Turn meter switch to TORQUE. Rotate torque/zero adjustment knob (19-2) clockwise or counterclockwise until torque registers zero.
6. Do not apply load yet. Operate machine at  $1000 \pm 50$  RPM for approximately 3 minutes or until the torque zero reading stabilizes (ceases to drift appreciably). Reset torque knob (19-2) to zero, if necessary.
7. Position torque arm (2) so that it fits inside concave portion of torque arm clamp (10), making sure not to apply load yet.
8. Fill stainless steel sample cup (A7) with distilled water. Place on cup stand (15), and raise cup stand so that test ring, test block, and block holder are immersed in fluid. Tighten thumb screw (30). (Refer to Fig. 1)
9. Rotate torque adjust handle (12) clockwise so that torque is increased at the rate of 5 inch-pounds (.565 N·m) per second until torque meter attains torque reading of 150 inch-pounds (16.95 N·m). Operate for 4 to 5 minutes or until a seizure occurs. If seizure occurs, remove load quickly.
10. Remove load by rotating torque adjust handle counterclockwise until torque is completely released from main shaft (8). When torque registers zero, turn power off. Lower cup stand. Turn torque arm clamp (10) up and away. Swing torque arm (2) back to allow removal of test block. Remove and clean test block.

(Exhibit B)

11. Observe scar left on block by ring. Refer to Fig. 6. Proper alignment of the test block in the holder will be indicated by the appearance of a rectangular scar on the test block (Fig. 6 Ex. C). An improper alignment will be indicated by the appearance of a triangular or trapezoidal shape, (Fig. 6, Ex. A & B). If alignment is proper, proceed to Section C.

## B. BLOCK ALIGNMENT

If improperly aligned, block and block holder must be repositioned.

1. Check to be sure there is no play between the block holder and the shoulder at the bottom of the threads on the torque shaft bushing. Any looseness (up and down motion) must be corrected. Remove block holder (7), clean, and reinstall against the shoulder of bushing (3), onto keyed shaft (6), and tighten socket cap screw. Make sure "O" ring (4), if used, is in place.
2. Depending on the shape of the triangle or trapezoid, adjust block holder either upward or downward. If trapezoid appears larger on top than on bottom (Fig. 6, Ex. A), holder must be adjusted downward.
3. Loosen bushing adjuster lock screw (32). Tighten torque arm adjusting nut (A1) until finger tight against shoulder at bottom of shaft.
4. Place 3/4" eccentric shaft wrench (A4) on threaded shaft flat and place 1-1/4" torque adjust wrench (A3) on torque bushing adjusting nut (A1). Tighten nut (A1) pulling eccentric shaft downward in increments of .005 inch (.13 mm) to .010 inch (.25 mm)(1/12 to 1/6 turn) until a rectangular pattern is obtained. If the pattern changes as shown in Fig. 6, Ex. B, Refer to Step 7 below.

### CAUTION

DO NOT ALLOW ECCENTRIC BUSHING TO  
ROTATE AS THIS WILL DESTROY THE LUBRICITY  
ADJUSTMENTS

5. Tighten socket head screw (32).
6. Position block on block holder so that a new side will come in contact with the ring. (Eight tests can be run on one block.) Repeat the test outlined in Section 5-A, steps 1-10 above to obtain a rectangular scar. If required, continue to repeat until a rectangular scar is obtained.
7. If the trapezoid appears smaller on top than on the bottom (Fig. 6, Ex. B), loosen bushing adjuster lock screw (32) and loosen the adjusting nut (A1) one revolution (1/16 inch (1.5 mm)).
8. Tap end of shaft upwards about 1/16 inch (1.5 mm) or until nut is against shoulder.
9. Adjust block holder downward in increments of .005 inches (.13 mm) or .010 inches (.25 mm) as described in Section 5-A, steps 1-6 until a rectangular pattern is obtained.

(Exhibit B)

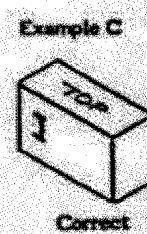
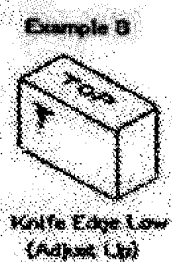
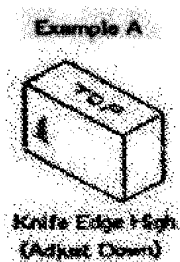
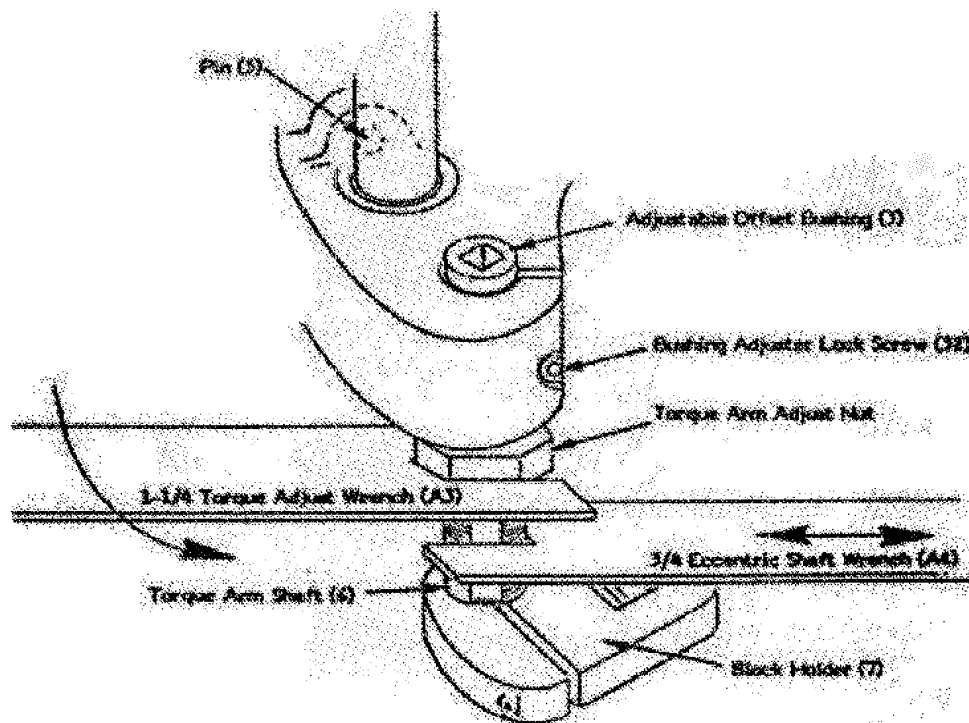


Fig. 6 - ADJUSTMENT TO CORRECT TRAPEZOIDAL PATTERN PROBLEMS OF EP TEST BLOCK

(Exhibit B)

### C. EP TEST PROCEDURE ON SAMPLE

The EP Test is used to determine the load or pressure the lubricant will hold without a complete breakdown of film strength. This is termed a *PASS*. Breakdown of lubrication film allows metal to metal contact, which causes galling and is termed a *SEIZURE*.

A *PASS* may be identified in one of two different ways. One type of pass is a 5-minute run at a constant load during which the torque meter reading remains essentially constant and the wear surface is small and polished. The other type is 5-minute run in which there is a moderate amount of torque meter deflection and the wear surface is moderate and either may be polished or dulled, depending on the abrasiveness of the sample.

A *SEIZURE* is defined as tearing and galling (scarring) of the metal in contact between the test ring and test block surfaces, representing a complete breakdown of the lubricating ability possessed by the drilling fluid under test. A seizure is identified by a rapid, as opposed to slow, rise in torque reading. (A seizure also may appear as a sharp, substantial increase in torque which drops back to normal. This second type of seizure usually occurs at a relatively low torque reading or during tests of highly abrasive drilling fluids or drilling fluids with high solids content). A seizure is accompanied by an obvious change in the pitch (sound) of the machine, usually a sudden rasping sound or, in the case of the second type, an intermittent rasping sound. After a seizure, the wear surface on the test block will be very large and will appear very rough and scarred. The surface of the test ring also will be rough and scarred.

1. Install new test ring squarely onto tapered portion of shaft (8). Then, using wrench A2, secure with test ring retainer Nut (9). Engage shaft lock plunger (5) in hole in shaft to prevent shaft rotation while retainer nut is tightened. Take care not to contaminate outside of test ring. Contamination by skin oil can cause inaccurate test results.
2. Place EP test block in block holder (7), making sure a new side will contact ring.
3. With meter switch (19-3) in RPM position, turn power switch (18-1) to "ON". Rotate speed control knob (19-1) clockwise or counterclockwise until torque/RPM meter (18-2) registers  $1000 \pm 100$  RPM.
4. Turn meter switch to TORQUE. Rotate torque/zero adjustment knob (19-2) clockwise or counterclockwise until torque registers zero.
5. **DO NOT** apply load yet. Operate machine at  $1000 \pm 50$  RPM for approximately 3 minutes or until the torque zero reading stabilizes (ceases to drift appreciably). Reset knob (19-2) to zero, if necessary. Turn machine OFF.
6. Position torque arm (2) so that it fits inside concave portion of torque arm clamp (10), making sure not to apply load yet.
7. Fill stainless steel sample cup (A7) with sample to be tested. Place on cup stand (15), and raise cup stand so that test ring, test block, and block holder are immersed in fluid. Tighten thumb screw (30). Turn machine ON.
8. Rotate torque adjust handle (12) clockwise so that torque is increased at the rate of 5 inch-pounds (.565 N·m) per second until an acceptable loading for the sample is reached, then operate for 4 to 5 minutes. If the maximum film strength is to be determined, continue the loading until a seizure is encountered. Note the maximum load (torque wrench reading). When seizure occurs, remove load quickly.
9. Repeat the test, using a new block surface and limiting the load to 50 inch-pounds (5.65 N·m) under where a seizure occurred and try for a Pass.
10. Repeat 9 above if necessary to obtain a pass.

---

(Exhibit B)

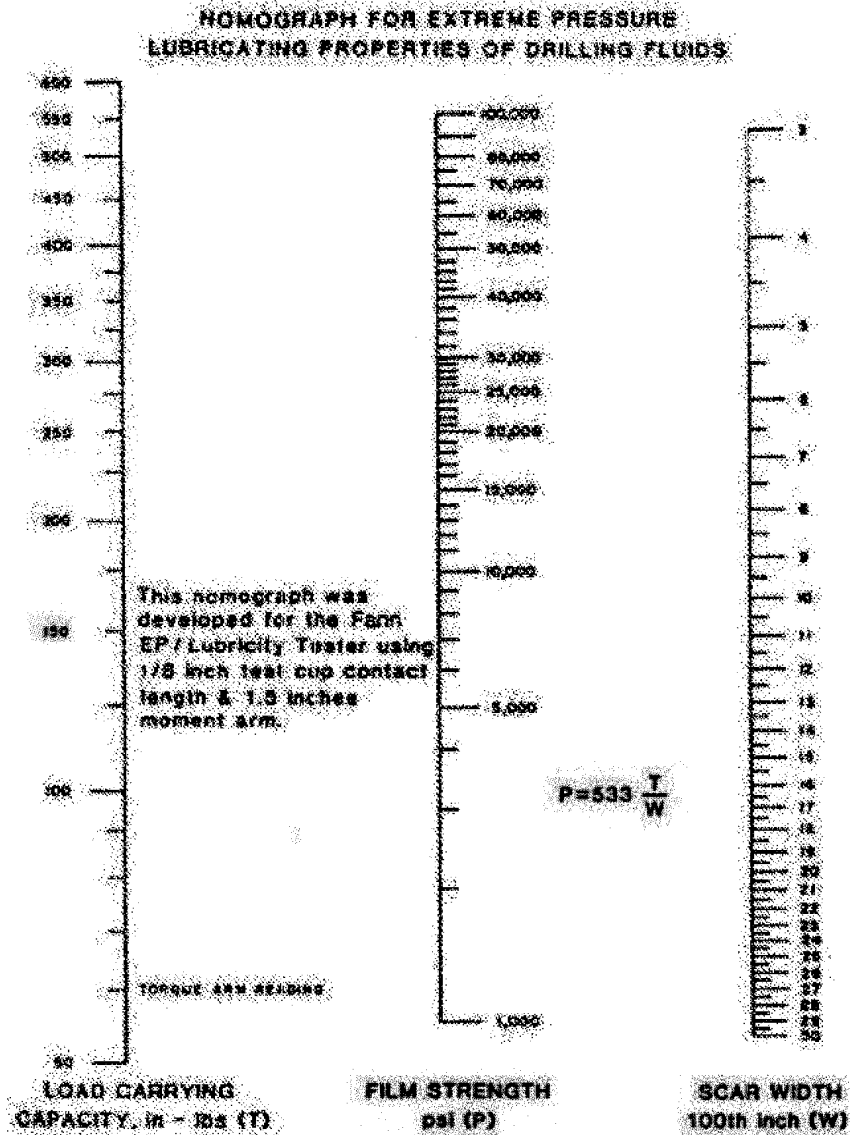


Fig. 7 - NOMOGRAPH FOR EXTREME PRESSURE

(Exhibit B)

#### D. EP CALCULATIONS AND MEASUREMENTS

1. To measure scar width on the block, use a magnifier calibrated to read to 0.005 inch (0.13 mm). An appropriate magnified may be obtained from Fann Instrument Company, Part No. 21239. Before measuring, the test block should be wiped clean. The magnifier is placed at the center of the scar, parallel to the edges so that the average width of the scar can be obtained. The scar measurement is taken in hundredths of inches. Thus when a scar width of 0.095 inch, for example, is measured, it should be referred to and recorded as 9.5 hundredths of an inch.
2. To calculate the pressure on the block, compute the area of the scar, which is found by multiplying the width of the scar by its length. The length is a constant 0.125 inches (3.18 mm). Area = Width (W) X 0.125. The force acting on the scar area is found by dividing the torque meter reading at which a Pass was obtained by the lever arm, which is a constant of 1.5 inches. The pressure on the test block at the time the test was stopped is found by dividing this force by the scar area. This pressure is referred to as the film strength of the sample. An equation for the calculation is written as follows:

$$P = \frac{\text{Force}}{\text{Unit Area}} = \frac{T / 1.5}{W \times .01 \times .125}$$

$$P = 533 \frac{T}{W}$$

Where P = Film Strength, psi  
T = Torque meter reading, inch-pounds  
W = Scar width, hundredths of an inch

#### NOTE:

W contains square inch units. The Nomograph shown in Fig. 7 may be used to derive the film strength without calculation.

#### E. REPORTING TEST RESULTS

1. The lowest load (torque meter reading) in inch-pounds and the average torque in inch-pounds at which the seizure occurred are recorded.
2. Record the following at the conclusion of a Pass or if a 5-minute test does not produce a seizure:
  - a. Load (torque meter reading) in inch-pounds.
  - b. Scar width in hundredths of an inch.
  - c. Film strength in psi.
  - d. Average torque meter reading in inch-pounds.

(Exhibit B)

## SECTION 6

### PREVENTATIVE MAINTENANCE AND MECHANICAL REPAIR

- A. The area in contact with the sample must be thoroughly cleaned after completion of tests. This includes the lower end of main shaft.(8), test ring (A5), retainer nut (9), block holder (7), block (A6), adjustable offset bushing threads (3), and adjusting nut (A1). If the machine is to be stored for a long period, coat the above areas with oil to prevent rusting.
- B. Avoid fluid spillage on control panel, since this can seep around electrical components and cause electrical damage to the components. Disconnect the machine and remove panel, if required for cleaning.
- C. After extensive use, check belt tension. Ensure sufficient tightness to that when the motor stalls, the belt does not slip. To adjust belt tension, Refer to 1-3 below.
  - 1. Remove belt guard (16) top half by removing 4 screws.
  - 2. Loosen motor mount bolts and slide motor toward torque adjust handle, then re-tighten mounting bolts. Make sure motor remains square with frame thereby maintaining pulley alignment.
  - 3. Replace belt guard. Tighten screws.
- D. The roller bearing (lower bearing) of the main shaft is greased with high temperature grease such as Lubriplate #12601®, via the zerk fitting (37). This bearing should be greased each 6 months under normal use. Do not over grease. The top bearing and torque shaft **DO NOT** require grease.
- E. BEARING AND/OR SEAL REPLACEMENT

Bearing and/or seal replacement requires the removal of the main shaft.

- 1. Remove top section of belt guard (4 screws).
- 2. Loosen motor mount bolts and release belt tension, then remove belt.
- 3. Remove 3 hub to pulley bolts in driven pulley (35). Screw these bolts into the tapped holes in the pulley to separate pulley from hub and remove pulley. Remove hub from shaft.
- 4. Bend tang of tang washer (40) out of the slot in nut (23). Holding shaft with shaft lock button (5), remove shaft nut (23) and tang washer (40).
- 5. Tap the top of shaft (8) with soft hammer to drive shaft downward out of top bearing (24). Shaft is removed downward through the bottom bearing.
- 6. To remove top bearing (24), remove the 3 screws holding bearing cap (4), then remove the cap. Tap bearing upward and remove.
- 7. To replace lower bearing and seals, remove lower seal (27) with a suitable seal puller. Slide lower needle bearing (28) out the bottom of casting. The top seal (26) now can be removed upward from the casting.
- 8. The inner lower bearing race (29) is pressed onto the shaft. It should not be removed unless it is to be replaced. Extreme care must be used when removing this race to avoid bending the shaft. Heating the race will assist in releasing the press fit. Using a suitable punch, drive sleeve toward top of shaft.

( Exhibit B )

9. Install new lower bearing outer race (29) in casting bore using a suitable washer and puller bolt. **DO NOT** hammer on this race. Position bottom edge of race 4-13/16 (4.812) inches or (122.3 mm) from bearing seat in top bearing housing of casting or, if top bearing was not removed, the bottom surface of top ball bearing (24).
10. Install top seal lip down and flush with top of casting. Use washers and puller bolt.
11. Install double lip lower seal (27). Install seal flat side down and flush with bottom side of casting.
12. If the top ball bearing was removed, install a new sealed bearing (24), then replace the bearing cap (4) and 3 screws.
13. If the lower bearing inner race (29) was removed, a new inner must be pressed onto shaft (8). Thoroughly clean shaft, remove any rough spots or burrs, then lubricate the area where inner race is to be located. Press, **DO NOT HAMMER**, inner race sleeve onto shaft.
14. Lubricate lower bearing (28) and seals (26) and (27) with a good grease, such as Lubriplate #12601, then carefully slide shaft through from bottom being careful not to damage lips of seals. Install shaft tang washer (40), tangs upward, and shaft nut (23), with bevel downward onto shaft. Tighten to 35 to 40 foot-pounds (47 to 54 N·m), then bend one tang into a slot of nut as a lock.
15. Reassemble pulley hub, and pulley (25), then belt (34).
16. Tension belt and tighten motor mount bolts (25 to 30 foot pounds (34 to 41 N·m)). Make sure motor remains square with frame thereby maintaining pulley alignment.
17. Replace belt guard (4 screws).

#### F. TORQUE SHAFT AND/OR CAM BUSHING REMOVAL AND REPLACEMENT

##### CAUTION

DO NOT REMOVE THE CAM BUSHING OR OFFSET BUSHING UNLESS THEY ARE TO BE REPLACED. IF THIS OCCURS, ALL CALIBRATIONS WILL BE LOST AND WILL REQUIRE READJUSTMENT.

The torque shaft (6) is treated with a dry film lubricant and should never be sanded or filed. Clean using a soft cloth.

1. Remove torque wrench (2).
2. Loosen the socket head cap screw in the test block holder (7), then using a screwdriver to slightly widen the slot, slide the block holder off the shaft. Remove key from shaft.
3. Remove shaft (6) upward out of the bushing, then remove "O" ring from bottom of offset bushing.
4. Loosen bushing lock screw (32) in lower bearing housing, then remove offset bushing toward bottom. A suitable bolt and puller may be necessary.
5. Install new offset bushing (3) with thick side to right of machine and install upward in housing with lower end approximately 3/8 inch above center of taper on main shaft (8). The exact position will be adjusted later.

(Exhibit B)

6. Install adjusting nut (A1), do not tighten.
7. Install "O" ring (41) in groove at lower end of bushing. Use grease to hold "O" ring in place.
8. Install torque shaft (6) from top, and install key.
9. Slide block holder (7) upward onto torque shaft making sure "O" ring is properly seated and key is in place. **DO NOT** leave any vertical play in the assembly. However, when rotated with the torque wrench, no reading should be observed. Tighten lock bolt in block holder (7).
10. Adjust cam rotation to obtain a centered pattern on the test block as described in Fig. 5 and Section 4-B "STANDARDIZING BLOCK AND RING."
11. Adjust cam elevation as described in Fig. 6 and Section 5-B "BLOCK ALIGNMENT".
12. After completion of all adjustments, make sure bushing lock screw (32) is tight (20 to 25 foot-pounds (27 to 34 N·m)).

( Exhibit B )

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**( Exhibit B )**

## SECTION 7

### CALIBRATION CHECK AND ELECTRICAL ADJUSTMENT

The EP Lubricity Tester is carefully calibrated when manufactured, and no additional adjustments should be necessary. However, with use and age, it may become desirable to check, and possibly readjust the instrument. A functional diagram is shown in Fig. 8. The procedure as described in Section A below is provided for this purpose.

#### A. CALIBRATION CHECK

This procedure requires a calibrated ring-block pair (Part No. 21034) and the accompanying data sheet. The data represents the data this particular pair produced on a prony brake calibrated instrument.

1. The block holder and main shaft must be cleaned.
2. Use distilled water (not deionized) as the test medium.
3. Check for the correct distance from torque shaft to main shaft (eccentric adjustment). The wear pattern should match as closely as possible the shiny zone on the block of the ring-block pair being used. (Refer to Section 3, and Fig. 5, Example C).
4. Also check to determine whether the block holder requires adjustment up or down to match shiny zone on the block. If adjustment is required, Refer to Section 5-B "BLOCK ALIGNMENT" and Fig. 6.
5. The difference in these readings at 150 inch-pounds (16.95 N·m) and 60 RPM's from this instrument and the original RUN readings is the percent calibration error in this unit. If the percentage is not over 10% and readings do not fluctuate more than 5 units in 5 minutes, a new calibration factor can be used. Refer to Section 4-D "CORRECTION FACTOR".
6. If the error is over 10%, the machine probably has:
  - a. worn main bearing
  - b. worn motor bearings
  - c. belt slippage
  - d. brush contact corrosion, or other problem requiring repair. Refer to Section 6 "PREVENTATIVE MAINTENANCE AND MECHANICAL REPAIR."

#### B. PREPARATION FOR SPEED AND TORQUE CALIBRATION

If the calibration check procedure outlined above in Section 7-A is insufficient, the complete procedure for torque adjustment and calibration is as follows:

1. The following equipment is required for this calibration:
  - a. Wooden block, approximately 1-1/2" X 3-1/2" X 6" (3.8 cm X 8.9 cm X 15.2 cm) long with a 3/16" (.47 cm) slot cut along its 6" dimension or other suitable holder for panel (Front Panel support).
  - b. Small insulated screwdriver. (potentiometer adjustment)
  - c. Prony Brake. (Refer to Fig. 9)
  - d. 1000 gram weight. (For prony brake)
  - e. Cardboard or insulating board, to prevent accidental shorting.

(Exhibit B)

- f. Tachometer or Stroboscope. (For measuring speed)

### CAUTION

THIS PROCEDURE INVOLVES OPERATING THE MACHINE WITH ITS CONTROL PANEL REMOVED WHICH EXPOSES, UNPROTECTED, HIGH VOLTAGE TERMINALS. TOUCHING OR ALLOWING THESE TERMINALS TO TOUCH THE MACHINE OR WORK SURFACE CAN CAUSE DAMAGE AND INJURY.

2. Make sure the machine is unplugged at the electrical outlet. Remove 4 panel screws, then tilt panel up and forward. Set on edge in the wooden block, with the bottom edge of the panel in the slot of the block, or otherwise suitably secure the panel on edge, with the panel vertical. Refer to Fig. 8 and 9. With panel so supported, in front of frame, place a cardboard insulation between back of PC card and frame. Panel should be right side up. All procedures of this section must be performed with the panel removed as described above.
3. Turn meter switch (on Front Panel) to RPM position.
4. See that meter reads zero (if not, adjust meter screw for zero).

NOTE: The zero on the meter may shift slightly with the position of the meter.

5. Turn on power. The meter must remain at zero with no rotation (set MIN for no rotation, reference Fig. 10).
6. Rotate speed knob (19-1) clockwise and check direction of rotation. Allow to run 2-3 minutes noting direction of main shaft rotation. Rotation should be clockwise looking down onto belt guard. If not, reverse motor leads (A+ & 3) at motor.

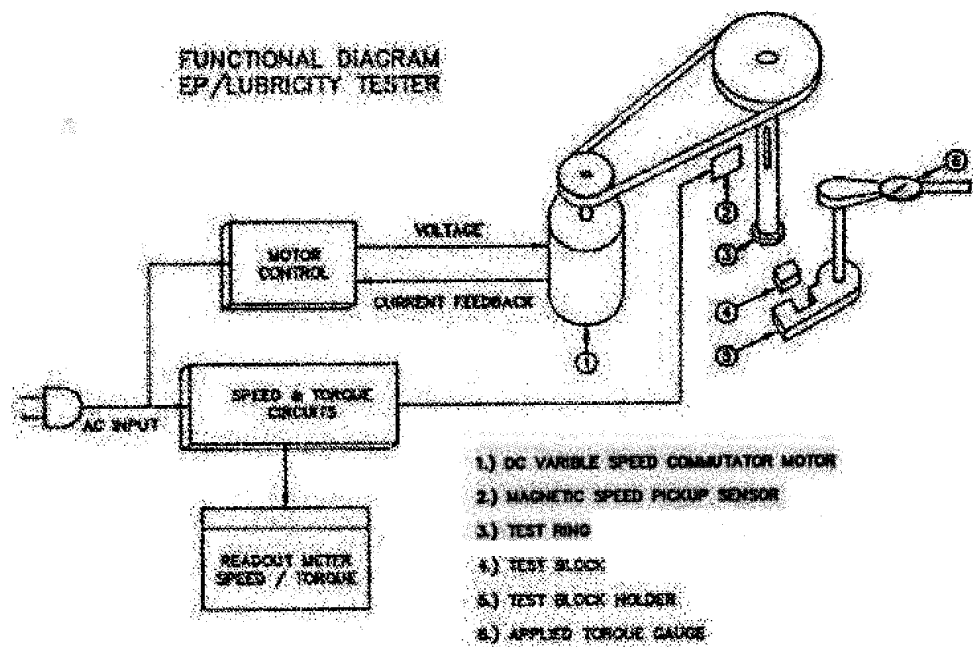
### C. SPEED ADJUSTMENT AND CALIBRATION

If the calibration check procedure outlined above in Part A is insufficient, the complete procedure for speed adjustment and calibration is as follows:

Speed Adjustment 1000 RPM/60 RPM. Use an RPM measuring device such as a non-contacting tachometer that is accurate or a strobe light. A contact type tachometer may be used but the accuracy will not be as precise. Fig. 11 shows using a non-contacting tachometer.

1. Remove belt guard (16) top section (4 screws). Place two reflector tape strips for tachometer on driven sheave (35), (no contact tachometer). Refer to Fig. 11. These are placed 180° apart. Turn outer panel speed control knob (19-1) all the way clockwise. Then turn back until sheave reflectors stand still with the strobe light set at 2000 or until tachometer reads 2000. (This is actually 1000 RPM).
2. Locate PC board potentiometer R5 (Fig. 10) and adjust meter to 1000 RPM. If speed will not reach 1000 RPM, turn "MAX" (Fig. 10) potentiometer on motor control until 1050 RPM is attained with speed control (19-1) full clockwise, then adjust control (19-1) to 1000 RPM.
3. Turn outer panel speed control knob (19-1) all the way counterclockwise. Adjust motor controller potentiometer labeled "MIN" (Fig. 10) until panel meter reads 40-50 RPM. Turn panel speed control knob (19-1) all the way clockwise and read 1025-1050 RPM. Repeat adjustments if necessary.

(Exhibit B)



**Fig. 8 - FUNCTIONAL DIAGRAM EP/LUBRICITY TESTER**

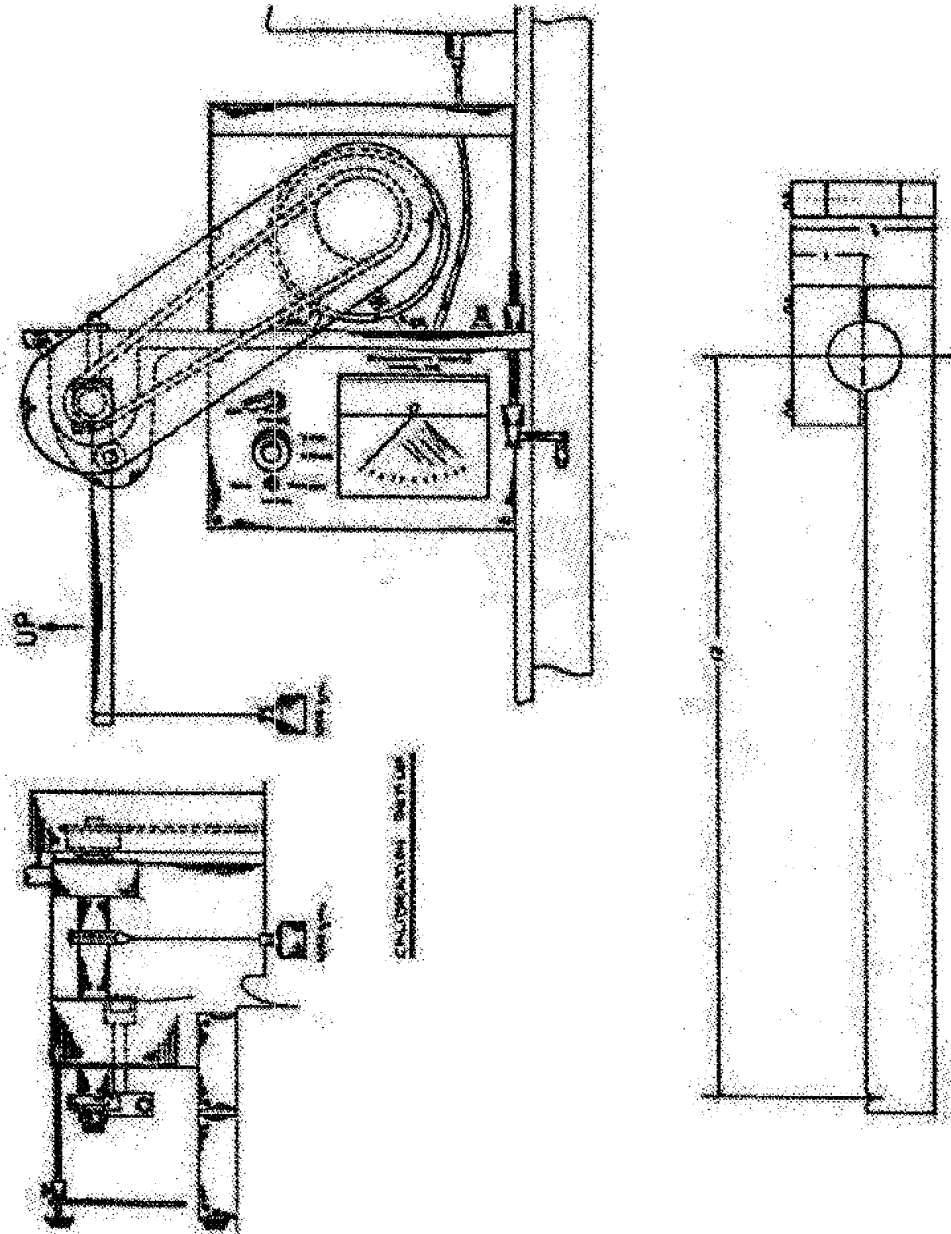


Fig. 9 - PRONY BRAKE CALIBRATION SET UP

(Exhibit B)

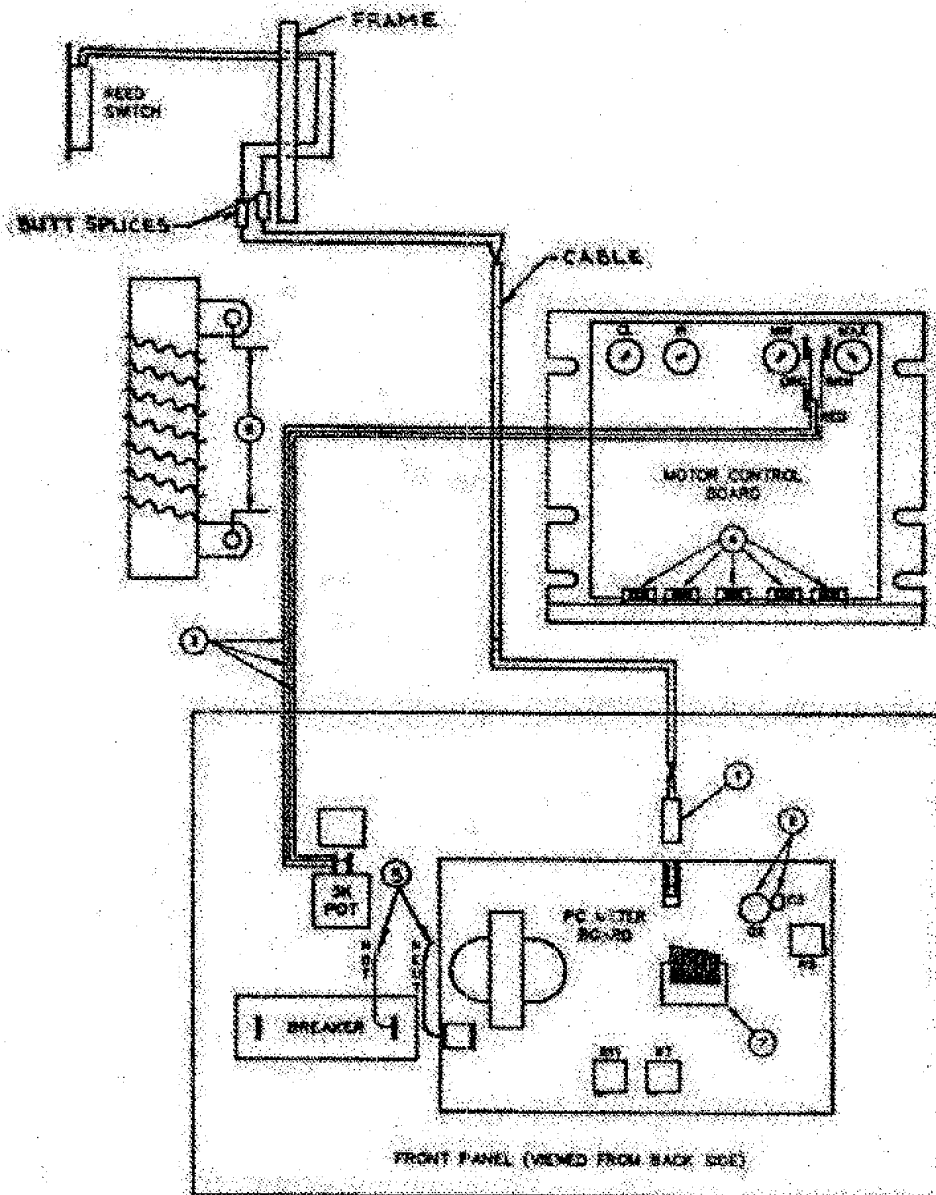
#### D. MOTOR TORQUE ADJUSTMENT ON MOTOR CONTROL BOARD

1. Set RPM to 60. Install a "worn-in" lubricity wear block into the test block holder and distilled water in the sample cup. Operate the machine at 150 inch-pounds (16.95 N·m) on the torque wrench. Refer to Section 4-B "STANDARDIZING BLOCK AND RING" for details. Watch RPM meter for speed-up or slowdown, while loading from 0 to 150 inch-pounds (16.95 N·m) and back to 0 inch-pounds.
2. Adjust "IR" compensating potentiometer (Refer to Fig. 10) on motor controller until speed with no load and speed with 150 inch-pounds (16.95 N·m) is the same at 60 RPM. If motor slows with 150 inch-pounds (16.95 N·m) load, increase "IR"; if motor speeds up with the 150 inch-pounds (16.95 N·m) load, decrease "IR". If motor stalls, increase "CL" (current limit pot) setting on motor control board. (Refer to Fig. 10)

#### E. PRONY BRAKE TORQUE CALIBRATION

1. Turn unit on its side and install prony brake on the main shaft between the upper and lower bearing housing as shown in Fig. 9. Make sure panel is temporarily supported and no electrical connections can short or may be touched.
2. Turn Panel "meter" switch (19-3) to "torque" position, and turn speed control (19-1) to far counterclockwise and torque zero knob (19-2) to mid-range. Turn the machine on. Adjust torque zero pot R7 (Refer to Fig. 10) to zero on meter.
3. Adjust speed to 60 RPM, then adjust the tightness of the screws in the prony brake until it balances horizontally with the 1000 gram weight hanging in the notch. Make sure that the speed is maintained at 60 RPM. Carefully support arm of prony brake until screws are sufficiently tight. The arm of prony brake must be maintained as nearly horizontal as possible. (Refer to Fig. 9)
4. Adjust PC meter board potentiometer R11 to 41.0-41.5 units of torque on meter. Refer to Fig. 10.
5. Release prony brake by removing weight and/or loosening bolts and adjust zero potentiometer (R-7) on meter board so that meter in torque mode reads zero. Refer to Fig. 10.
6. If necessary, repeat steps 4 and 5 above until the 41.0-41.5 and zero are maintained with no further adjustments. Make certain that torque zero panel knob (19-2) stays in mid-range throughout this procedure.
7. Turn panel outer speed knob all the way clockwise and note torque zero shift. This should be less than 5 units of torque. Be sure that center zero knob can zero meter and readjust meter board potentiometer R-7 to zero if necessary, and repeat steps 4 through 6 above.
8. Return speed to 60 RPM and note torque zero. Adjust center knob to attain torque zero. Readjust R-7 slightly until meter torque zero can be obtained at both 60 and 1000 RPM. Return torque meter to zero using center knob.
9. Remove prony brake and reassemble panel onto instrument making sure wires are properly routed and not pinched.

(Exhibit B)



(Exhibit B)

Fig. 10 - ELECTRONIC CONTROLS

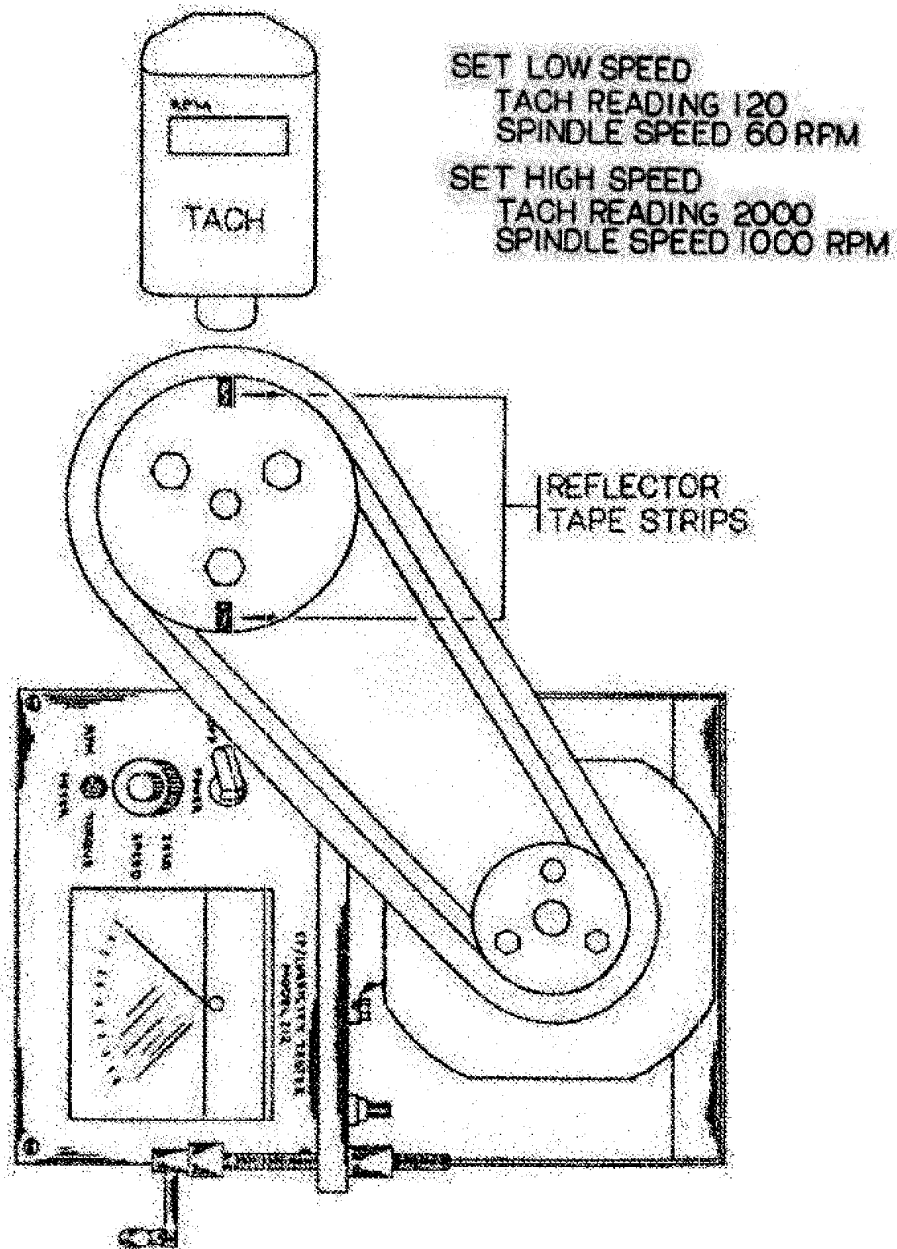


Fig. 11 - SPEED CALIBRATION

(Exhibit B)

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**(Exhibit B)**

## SECTION 8 ELECTRICAL MAINTENANCE AND DIAGNOSIS

(Refer to Fig. 8 and 10)

### PROBLEM

### CAUSES

#### A. LOSS OF RPM READING

1. Make sure reed switch connector is plugged in to circuit board header.
2. Check the Reed switch function (sensing bar magnets on main shaft). Signal may not be reaching circuit board at connector (1) Fig. 10. Place Ohm meter lead in receptacle (1) from switch and turn shaft magnets past switch and note meter go low and high on ohms reading. If no switching, adjust bracket by bending or move bracket to respond to magnet movement.
3. If switch is switching, and signal is entering circuit board, measure on base of Q<sub>2</sub>. If the emitter of Q<sub>2</sub> is not sending signal to C<sub>3</sub>, then replace Q<sub>2</sub>.

#### B. LOSS OF POWER

1. The "ON" breaker may be opening because of a short hot to neutral (5) Fig. 10.
2. Unplug power cord, and using an ohmmeter, see if breaker is closed with the "ON" switch in the "ON" position.
3. Follow the heavy wires from (5) to find the short (hot to neutral or ground).

#### C. SPEED CONTROL ERRATIC

1. The unit may be operating on a "noisy" AC Power. The unit can pick up signals from other SCR control devices, if MOV is damaged or burned out by excessive noise.
2. A new line 120VAC MOV (METAL OXIDE VARISTOR) will quiet the unit down.

#### D. TORQUE READINGS LOW OR ERRATIC

1. Check the small white and yellow wires on the 0.1 ohm rib wound resistor (6) Fig. 10.
2. Repair if loose or broken.

#### E. LOSS OF BOTH TORQUE AND SPEED READINGS

1. Check 14 pin DIP plug (7) Fig. 10
2. Check speed-torque panel switch functions.

#### F. LOSS OF SPEED CONTROL

1. Check the 5K pot leads (3) Fig. 10 to motor control board.
2. Check SCR's (4) Fig. 10 on motor control board.

(Exhibit B)



FIG. (6) KBIC<sup>®</sup> SCHEMATIC

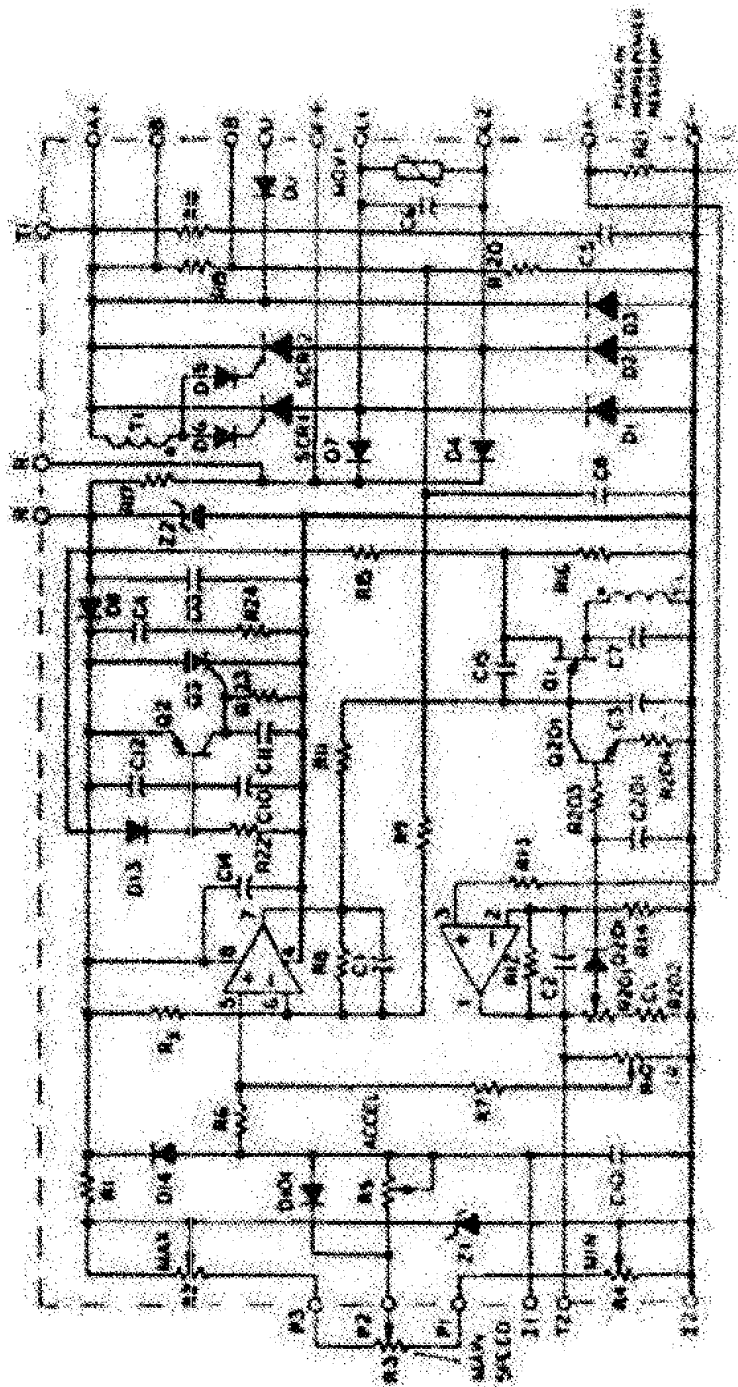


Fig. 13 - KBIC-9 CONTROL SCHEMATIC

(Exhibit B)

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**(Exhibit B)**

## SECTION 9 PARTS LISTS

### A REPLACEMENT PARTS

(For part identification, refer to item numbers, Fig. 2, 3 and 10)

PART NO	ITEM NO	DESCRIPTION
21203	3	Adjustable Offset Bushing
21204	4	Top Bearing Retainer
21205	5	Main Shaft Stop Assembly
21206	6	Torque Arm Shaft
21207	7	Block Holder Assembly
21209	9	Test Ring Retaining Nut
21210	11	Torque Wrench Clamp
21211	10	Torque Adjust Nut
21212	12	Torque Adjust Handle
21213	13	Torque Adjust Shaft
21214	14	Cup Stand Rod
21215	15	Cup Stand
21216	16	Belt Guard
21218	18	Panel, Front Control
L7103	19	Harness, Cable 14 Conductor with Plug
L6227	17	Switch, Reed
21224	8,29,25	Main Shaft w/Bearing Inner ring and Magnets
21226	A1	Torque Arm Adjust Nut
32900	30	1/4 - 20 Thumb Screw
A5042	32	Lock Screw F/bushing
E3113	---	Strain Relief
L4030	31	Grease Fitting
L4320	2	Torque Arm (Torque Wrench)
L4512	---	11/16 x 1/2 x 3/32 Quad Ring
L4702	34	V-Belt
L4741	37	Motor Sheave with Bushing, 2.8" diameter

(Exhibit B)

**REPLACEMENT PARTS (cont.)**

PART NO.	ITEM NO.	DESCRIPTION
L4743	35	Main Shaft Sheave with Bushing, 4.7" diameter
L4803	23	Bearing Nut
L4813	40	Lock Washer
L4920	28	Roller Bearing
L4923	24	Ball Bearing
L4953	26	Grease Seal (Upper)
L4954	27	Grease Seal (Lower)
L6225	18-1	Circuit Breaker
L6226	19-3	Meter Switch, Bat Handle
L6227	17	Reed Switch
L6818	18-2	Torque/RPM Meter, 50 Microamp
L7113	38	7' AC Power Cord w/plug
L7202	19-1	Knob, Large (Speed Control)
L7203	19-2	Knob, Small (Torque/Zero Adjust)
L7213	36	Rubber Foot
L7251	22	RPM/Torque PC Board
L7523	20	Permanent Magnet Motor 56C Frame, 1750 RPM, 1/2 HP, 4.8A
L7524	21	Motor Speed Controller

**NON-REPLACEMENT PARTS**

*(For Part Identification, refer to item numbers, Fig. 2 and 3)*

PART NO.	ITEM NO.	DESCRIPTION
21201	1	Frame Assembly
E6017	33	Name Tag with Part & Serial Numbers

**(Exhibit B)**

## B. ACCESSORIES

(For part identification, refer to code numbers, Fig. 2 and 3.)

PART NO	ITEM NO	DESCRIPTION
20220	A7	Sample Cup
21010	A5	Test Ring -- EP Test
21012	A6	Test Block -- EP Test
21030	A5	Test Ring -- Lubricity Test
21032	A6	Test Block -- Lubricity Test
21034	---	Calibrated -- Lubricity Ring-Block Pair w/Data Sheet
21121	41	Instruction Manual
21229	A3,A4	Torque Adjust Wrenches (Set)
21230	---	Prony Brake
21239	---	Reticulated Magnifier
L4302	A2	Test Ring Replacement Wrench
L4332	A8	3/16 Allen Wrench
L5819	---	230 Vac Step Down Transformer (for 230-Volt Operation)

( Exhibit B )

**BOARD OF PATENT APPEALS AND INTERFERENCES  
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

<b>In re Application of:</b>	§	<b>Group Art Unit: 1797</b>
<b>OTTO, et al.</b>	§	
	§	
<b>Serial No.: 10/792,056</b>	§	
	§	<b>Examiner: Ellen M. McAvoy</b>
<b>Filed: March 3, 2004</b>	§	
	§	
<b>For: Method for Lubricating and/or</b>	§	<b>Atty. Docket: 154-28553-US</b>
<b>Reducing Corrosion of Drilling</b>	§	
<b>Equipment</b>	§	

**RELATED PROCEEDINGS APPENDIX**

None.